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TESTING OF CATSS AT NOBLE FORCE PROTECTION CONCEPT EXPERIMENT IN KIRKENES 22-24 NOVEMBER 2004

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8) ABSTRACT

The Chemical Atomic and Toxic compound Surveillance System (CATSS) was tested during the Force Protection Concept Experiment organised by NOBLE in Kirkenes 22-24 November 2004. In this experiment the CATSS system was tested under cold winter conditions in a realistic force protection setting. The first day, the system was placed near Svanvik with communication via FDN to the Command Centre at Høybuktmoen. The second day the CATSS unit was placed close to the Command Centre. Both set-ups worked well, but some minor problems and ideas for improvements were observed.

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CONTENTS

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1 INTRODUCTION

Detection and reporting of possible NBC-events are in the armies of most countries normally done manually. In case of chemical (C) events, detection is either carried out using CWA-sensitive detection paper, systems based on wet chemistry or CWA-sensitive electronic detectors. The following warning is conveyed by voice, cable or radio communication to neighbouring or higher units. The arrival of increasingly advanced command, control and information systems (C2IS) has actualised the demand for an automatic system which more or less unattended is able to detect, identify, warn and report a possible CWA-event. As Norway and many other countries to an increasing extent also are involved in peacekeeping operations in many regions around the world, the interest for a system which is able to detect releases of toxic industrial materials/chemicals (TIMs/TICs) or releases of radiological materials has occurred. For this reason, the Norwegian Defence Research Establishment (NDRE) initialised a project to assemble a demonstrator of an automatic and network based NBC surveillance system, named CATSS (Chemical, Atomic and Toxic compound Surveillance System). The system is based on off-the-shelf sensor equipment. The main activities so far have consisted of programming and interfacing to connect the information from various sensors to a CPU carrying out logging, computing and data treatment. An overview of the CATSS is given in (1) and a detailed description of the associated software is given in (2).

In November 2004, FFI was invited to take part in a Force Protection Concept Experiment (FPCX-3) carried out by the Norwegian Battle Lab & Experimentation (NOBLE) at Høybuktmoen close to Kirkenes. NOBLE is a Joint Battle Lab that is supposed to carry out experimentation in a net centric environment. The host unit for this experiment was the National Border Guard at Garnisonen i Sør-Varanger (GSV). The hypotheses of the experiment were:

<u>H0.1 See first, more:</u>

a) A mix of networked, technical sensors creates a more effective surveillance and identification of potential threats against own forces or resources.
b) Automated tracking of own forces leads to more effective utilization of own resources.

<u>H0.2 Understand faster and better:</u>

a) A realistic fused and centralised common operational picture (COP) leads to faster and better situational awareness of potential threats against own forces or resources.
b) A distributed COP leads to faster and better situational awareness at the recipient.

<u>H0.3 Decide better and faster:</u>

a) Improved local situational awareness leads to local self-synchronization.

b) Improved awareness of potential threats against own forces or resources leads to a shift from order-based management toward intention-based management.

<u>H0.4 Act decisively:</u>

a) Local units neutralize potential threats in a balanced and relevant way.

These hypotheses were tested at Kirkenes, by conducting an experiment that included a mixture of new technologies. Several different sensors were tested. Among these were:
ODIN – Balloon with camera
SAAB Safari with UAV pod for aerial surveillance
ACTD – radar sensors
Ground sensors
Mobile radars
CATSS – Chemical, Atomic and Toxic Compound Surveillance System

The operational picture was shown on a Common Operating Decision System (CODS) implemented by the company LENCO, and on a video screen in the command room at GSV (Figure 1.1), and also via a data link to Regional Command North (Landsdelskommando Nord-Norge, LDKN) in Bodø. The information from all the sensors was used by the National Border Guard to locate intruders crossing a defined borderline through air, on the ground and at sea.

Figure 1.1   Situational picture from the command room with CODS and a video screen

2 EXPERIMENT MASTER PLAN

Three different scenarios were put up. A force protection land - scenario on the first day, a force protection air (base defence) – scenario on the second day and a force protection maritime escort - scenario on the third day. Each scenario was run twice, both before lunch and after lunch. CATSS was not used during the third day of the experiment.

2.1 Day 1 – Land scenario

The mission was to locate an intruder who is crossing the defined borderline through air (helicopter) and on the ground. The sensors were therefore put up in the area shown on the map (Figure 2.1). In this scenario, the CATSS sensor was located at the observation post (OP) at Bjørnsundshøgda, close to Svanvik, 30 km south of Høybuktmoen. In this position, the CATSS sensor was monitoring the area for chemical, radiological and industrial agents, but was not a direct part in the experiment.

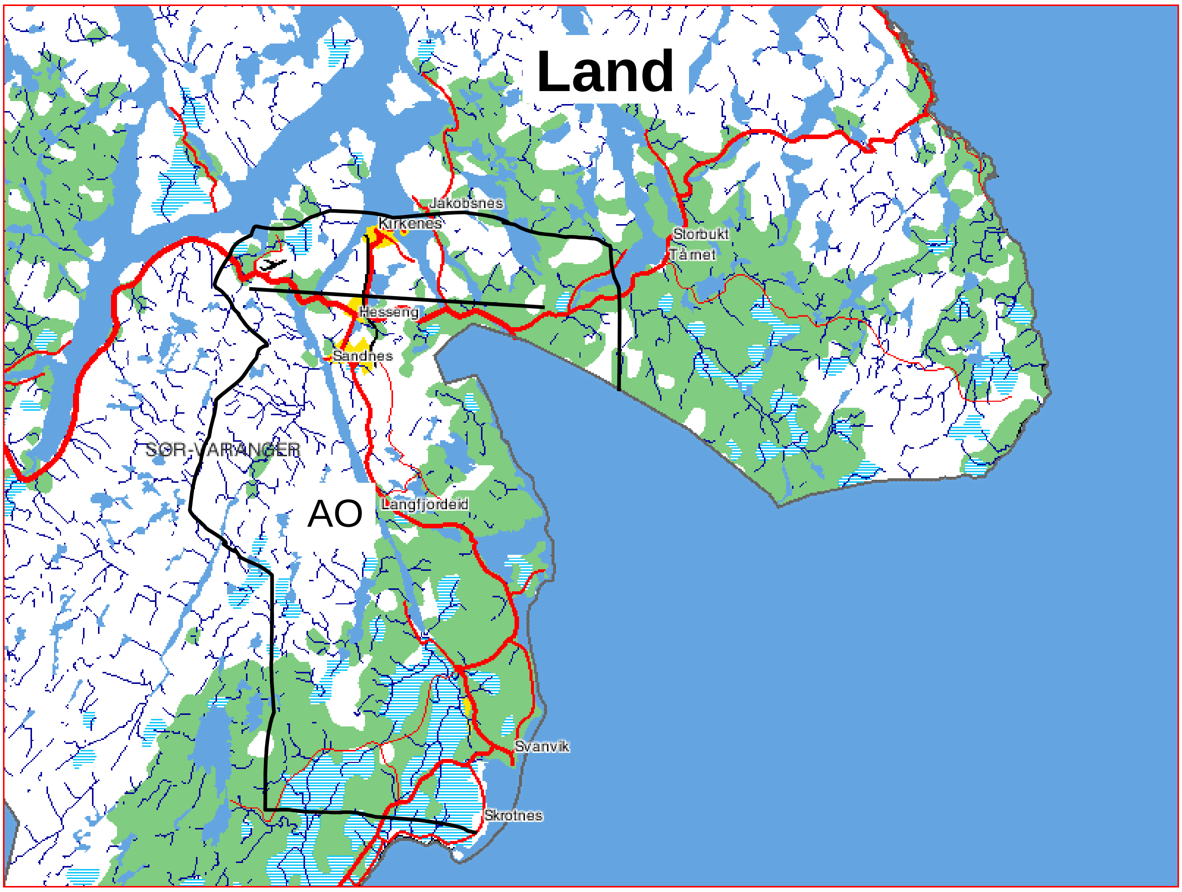

Figure 2.1 Day 1 – Land scenario

2.2 Day 2 – Base defence scenario

The mission was to locate enemy OP and laser illumination teams and, in addition, locate intruders crossing an already defined borderline around the base (Figure 2.2). In this scenario, the CATSS sensor was located close to the main building (headquarter) at GSV. In this position it acted as a close defence unit.

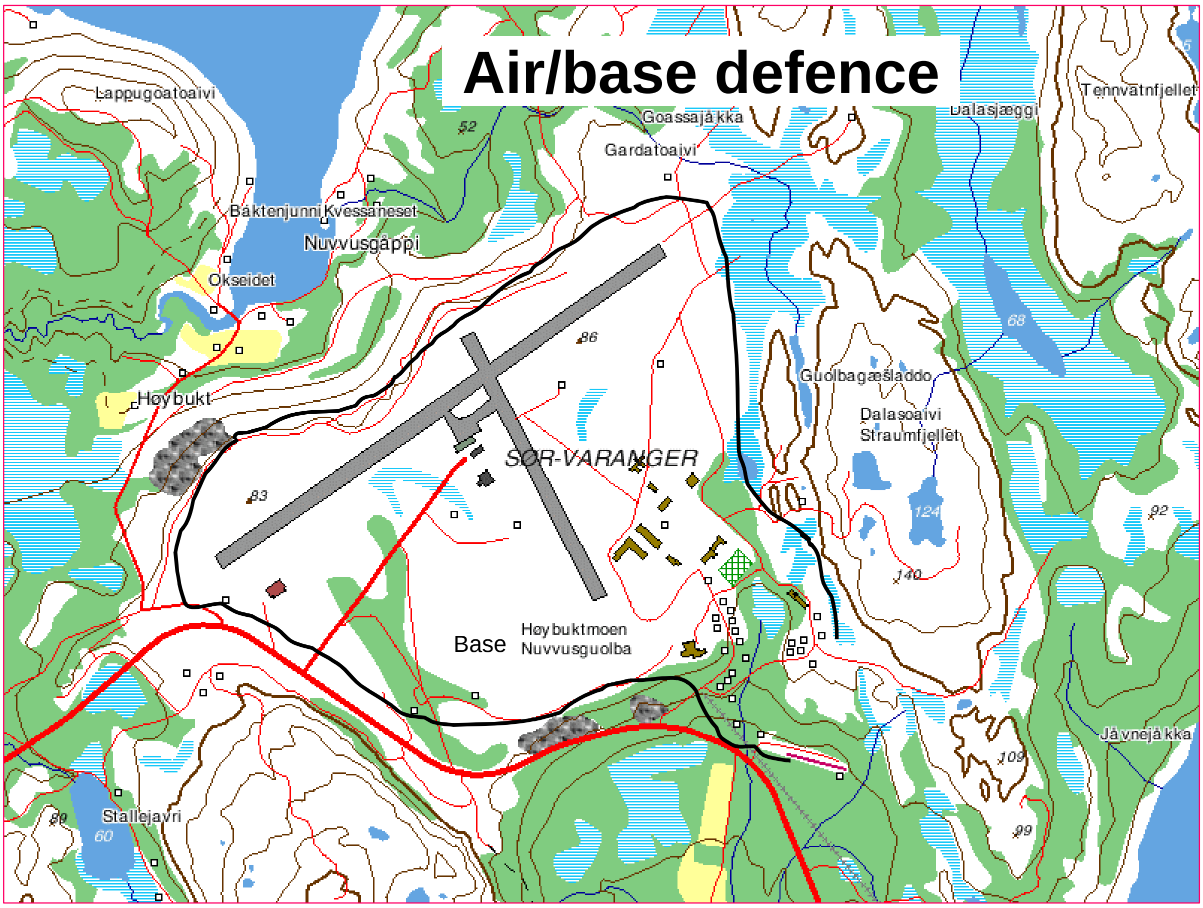

Figure 2.2   Day 2 – Base defence scenario

2.3 Day 3 – Maritime escort scenario

The mission was to locate potential threats when escorting a navy vessel into harbour/base and during alongside stay in harbour. The CATSS sensor was not used during this scenario.

3 CATSS TESTING

3.1 Set-up

Before set-up, the equipment was connected and tested at GSV to ensure that nothing was broken during transport (by air) to Kirkenes. After the initial test, the equipment was transported to Bjørnsundshøgda (near Svanvik) by car (Mercedes Gelendewagen) and set up. The time used for set-up was approximately 1.5 hours. This was done the day before the experiment started (Monday evening).

At the end of the first day of experimentation, the equipment was dismantled and transported back to GSV for the second experimentation day. This time the dismantling and set-up time was shorter, about 1 hour each, excluding transport time. The CATSS was run on external power (220 V) both days.

3.2 Data communication

Two different configurations were used for data communication during the two days of the experiment. The first day, at Bjørnsundshøgda, an Ethernet cable from the CATSS sensor was pulled inside the building to the CATSS central computer. This computer was then connected to the FDN line (2 Mbps) to GSV (approx 30 km). In this way the output from CATSS could easily be read out directly at GSV and the CATSS sensor could even be controlled from GSV. This worked very satisfactory. A schematic presentation of the sensors involved in the experiment is shown in Figure 3.1.

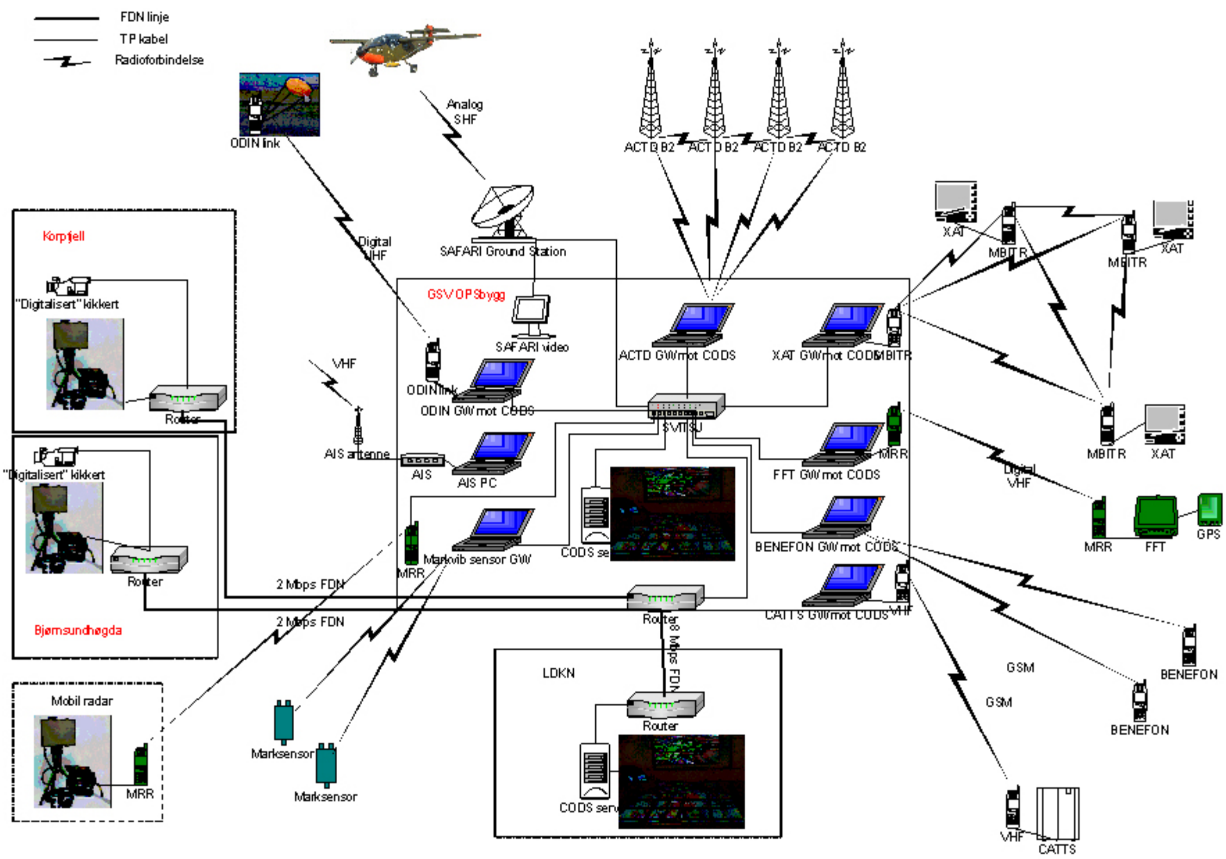

Figure 3.1 Schematic presentation of the sensors taking part in the experiment

The second day, when the CATSS sensor was placed outside the main building at GSV (see Figure 3.2), an Ethernet cable (60 m) was pulled to the CATSS central, set up inside the building. This central was then hooked up to the NOBLE data network at GSV. In this scenario it would have been advantageous to place the CATSS sensor a somewhat longer distance from the main building. This would have given more time for the personnel to take action in case of an alarm (e.g. don protective gear). The length of the Ethernet cable, and also the topography, restricted the distance from the main building in this setting. To ensure proper signal passage, the maximum Ethernet cable length is approximately 100 m.

Figure 3.2 CATSS sensor set up outside the main building at GSV

3.3 Alarm testing

An overview of the sensors currently installed in the CATSS unit is given in Table 3.1.

Sensor function	Model	Manufacturer
CWA	GID-3	Smiths Detection, UK
TICs	Multiwarn II	Dräger, Germany
Gamma radiation	Automess	Automation und Messtechnik, Germany
Wind	Ultrasonic	Gill Instruments, UK
Temp/Rel humidity	MTO	G.Lufft- und Regeltechnik, Germany
GPS	Acutime 2000	Trimble, USA

Table 3.1 Overview of the sensors installed in the CATSS

The GID-3 confidence tester in G-mode or in H-mode was in this experiment used to trigger alarms from CATSS. The advantage of using H-mode was that the GID-3 detector cleaned itself faster than using G-mode.

During day 1 (land scenario), the alarm was triggered once (at 1000 hours). The alarm reached GSV, but was not seen on CODS. The reason for this was that the map was zoomed in at an area closer to GSV than Bjørnsundshøgda, where the CATSS sensor was located.

During day 2 (base defence scenario), the alarm was triggered at 0930 hours in the morning (G-gas) and at 1350 hours in the afternoon (H-gas). During the morning session, some problems with the other sensors occurred, and the Commander did not get full use of the CODS display. During the afternoon session, however, the system worked much better (see Chapter 3.4 below).

3.4 Display in CODS

When the CATSS alarm was triggered, the affected sector was shown on the CODS as seen (simplified) in Figure 3.3. Because only the graphic sector, without any text box was shown on the CODS, John Tørnes was called inn to brief the Commander on the situation. The Commander was given the information that a CATSS station had detected mustard gas and that the affected area was as shown on the CODS. The Commander therefore ordered to don protective clothing immediately. The protective equipment in service would allow personnel to stay in a contaminated area for up to 24 hours. He decided, however, to withdraw personnel from the contaminated sector. This decision was not carried out because it was decided to continue the experiment as planned.

Figure 3.3 CATSS alarm displayed in CODS as a simplified picture

The wind sensor did not work properly during the test, and the sector shown is therefore towards north. The wind data from the meteorological office at Kirkenes airport was 15 knots (7.7 m/s) from 170 degrees at 1030 hours.

A text box should have been displayed on the CODS giving more detailed information on the chemical attack, together with the graphic sector. This text box (shown in Figure 3.4) was not implemented into the CODS at the time of the experiment.

Object Info Viewer

Name	CATSS hazard GSV
Group	
Date of update	2004-12-13 15:11:44.363
Registration Date	2004-12-13 15:11:44.363
Latitude	N 69° 43.171'
Longitude	E 029° 54.781'
Altitude	0
Wind direction	0 degrees
Material	H

Guide

GUIDE 153

SUBSTANCES - TOXIC and/or CORROSIVE (Combustible)

POTENTIAL HAZARDS

HEALTH

- TOXIC; inhalation, ingestion, or skin contact with material may cause severe injury or death.
- Contact with molten substance may cause severe burns to skin and eyes.
- Avoid any skin contact.
- Effects of contact or inhalation may be delayed.
- Fire may produce irritating, corrosive and/or toxic gases.
- Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution.

FIRE OR EXPLOSION

- Combustible material: may burn but does not ignite readily.
- When heated, vapors may form explosive mixtures with air: indoors, outdoors, and sewers explosion hazards.
- Those substances designated with a "P" may polymerize explosively when heated or involved in a fire.
- Contact with metals may evolve flammable hydrogen gas.
- Containers may explode when heated.
- Runoff may pollute waterways.
- Substance may be transported in a molten form.

PUBLIC SAFETY

CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate enclosed areas.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection.
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations.

EVACUATION

Figure 3.4 Text box, which should have been displayed on CODS in case of a CATSS alarm

The dimension of the affected sector was calculated based on the information given in the ERG2000 handbook as shown in Figure 3.5 (3). The first isolation distance is in the map shown as a red circle and the protective downwind distances for day and night are shown in orange and yellow colours respectively. The data for large spills are used in the display.

Table of Initial Isolation and Protective Action Distances

		SMALL SPILLS						LARGE SPILLS					
		First ISOLATE in all Directions		Then PROTECT persons Downwind during				First ISOLATE in all Directions		Then PROTECT persons Downwind during			
				DAY		NIGHT				DAY		NIGHT	
ID No.	Name of Material	Meters	(Feet)	Kms	(Miles)	Kms	(Miles)	Meters	(Feet)	Kms	(Miles)	Kms	(Miles)
2810	Mustard (when used as a weapon)	30	100	0.2	0.1	0.2	0.1	30	100	0.2	0.1	0.3	0.2

Figure 3.5 *Table of initial isolation and protective action distances taken from CANUTEC ERG2000*

The picture shown in Figure 3.3 is a simplified picture. An example of the real CODS picture is shown in Figure 3.6 below (without the CATSS warning).

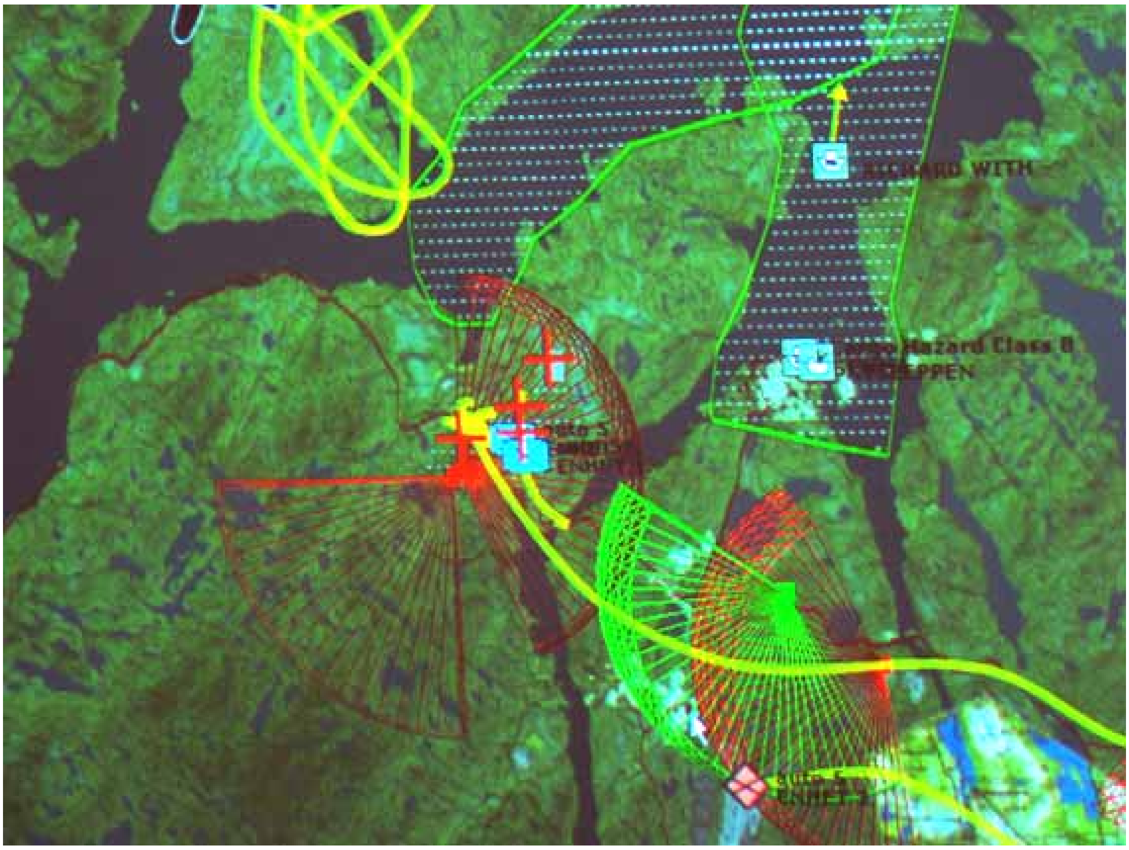

Figure 3.6 *Operational picture taken during day 2 of the experiment*

4 DISCUSSION AND RECOMMENDATIONS

The CATSS participation in the experiment was very successful. Some items were, however, observed where modifications should be carried out.

The conversion of GPS coordinates between geographical and Military Grid Reference System (MGRS) formats did not work properly. The current GPS-unit only produces geographical coordinates. They therefore need to be converted to MGRS format before displayed on the map. An error in the current conversion programme produced coordinates in Belarus instead of at GSV. The CATSS alarms therefore had to be drawn into correct position on the map manually.

There was also an error in the readout from the wind sensor. The sensor gave only sporadic data back to the central. The sensor also went off-line quite frequently. The plume on the map, indicating the affected sector, was therefore always directed towards north. This has to be checked out and corrected.

The NBC-4 messages produced by CATSS were not implemented in the CODS display. The NBC-4 message is a formatted text that is used to report detection data, monitoring, reconnaissance and survey results to the respective NBC Centre (4). This message is well known by the military commanders and should be shown on the CODS display immediately when the sensor is activated. This is a good example of issues we did not think of during the implementation of the CATSS information into CODS, but that became clear during the experiment. In some of the NBC-4 messages from the CATSS, all fields were empty. This is because of a glitch in the data system, which has not been found yet. An example of a chemical NBC-4 message created by CATSS is shown in Figure 4.1.

```
NBCEVENT/CHEM//
INDIA/UNK/NERV/-/ACD//
QUEBEC/35VPT126372/A/ACD//
SIERRA/240929ZNOV2004//
TANGO/URBAN/WOODS//
YANKEE/133DGT/1KPH//
ZULU/N/-12C/8/0/0//
GENTEXT/NBCINFO/H-HAZARD:3 ONLY TEMPERATURE AND HUMIDITY
        ARE MEASURED//
```

Figure 4.1 NBC-4 message created by CATSS at 09:29 hours on November 24. The position given in line Quebec is not correct

The location of the CATSS sensor during the last part of the experiment should have been further away from the main building at GSV, giving more time for the personnel to take action in case of an alarm. This would have required that the sensor run on batteries and a long Ethernet cable or a radio link between the sensor and the central. The current CATSS box can run on batteries but requires 3 heavy lead accumulators. It was therefore decided to use mains power during this experiment. Data communication will have to be done by cable or radio link. For the moment, the radio link is not operable. It is therefore necessary to use a cable between the sensor and the central (maximum length is 100 m using Ethernet cable). This worked well during the first part of the exercise, where the detector was located close to the OP at Bjørnsundshøgda with communication to GSV via FDN. During second part of the experiment, a radio link would have been advantageous. Work is underway to solve this problem.

The response time is critical when a CATSS alarm appears. It is important that the information is given to the Commander as soon as possible, so he can take immediate protective actions. A sound alarm from the CODS table could therefore be implemented to draw the Commanders attention to the alarm.

To help the Commander in obtaining a situational picture as complete as possible, if would be advantageous to have a dedicated symbol on the CODS display, showing where the CATSS units are placed out. In this way he will see on the display where the detectors are located before an alarm is triggered.

During the current experiment, text information about the detected agent was not displayed on the CODS. The time did not permit implementation of this feature into the CODS software. It was intended that a text box should appear on the display right after the alarm had gone off (see Figure 3.4). This would give the Commander additional information to help him take the necessary action. The idea was to display information retrieved from the emergency response guidebook ERG2000 (3). For the chemical warfare agents it is then necessary to have information about which agent has been detected (not only a G-gas or a H-gas). This information will be available when the new Lightweight Chemical Detector (LCD) is implemented into CATSS in the near future. As an alternative for the current experiment, John Tørnes explained orally to the Commander what the graphic sector that appeared on the CODS display meant.

An alternative or a supplement to using data from ERG2000 is using more detailed information about the release of chemical, radiological or industrial agents (e.g. calculations based on MTP-45 and prediction programmes). If such information exists, it will be possible to predict the affected area more precisely. It is recommended that an NBC-expert (NBC officer) is involved in the process to validate and supplement the data from CATSS.

5 CONCLUSIONS

It is very important to take part in exercises and experiments like this to discover problems that will not arise in a laboratory test. In the experiment near Kirkenes, the CATSS was tested under cold winter conditions over a period of two days. The first day the system was placed near Svanvik with communication via FDN to the Command Centre at Høybuktmoen. The second day, the CATSS unit was placed close to the Command Centre. Both set-ups worked well. Some minor problems and some ideas for improvements were observed. These are described in this report and will be corrected in the near future.

References

(1) Tørnes J Aa, Gran H Cr, Pedersen B, Opstad Aa M, Prydz P A, Wiik Ø, Nordahl A T (2004): Chemical, Atomic and Toxic compound Surveillance System - CATSS, FFI/RAPPPORT-2004/01661, Ugradert

(2) Prydz P A (2004): System documentation – Chemical Atomic and Toxic compound Surveillance System – CATSS, FFI/RAPPORT-2005/00057, Unntatt offentlighet

(3) ERG2000 (2000): Emergency Response Guidebook, CANUTEC Dangerous Goods Transport, Canada, Ottawa, Ontario

(4) North Atlantic Treaty Organisation/Partnership for Peace (NATO/PfP) (2003): Reporting nuclear detonations, biological and chemical attacks, and predicting and warning of associated hazards and hazard areas (multinational tactical publication - operators manual), MTP-45 (B)

APPENDIX

A EXTRACT OF MESSAGE LOGS AT 24 NOV 09:29:55

NBC-message (central)
[3105] (11-24-2004 09:29:55) : Sensor 8 - KKI (NBC Messages) -> NBCEVENT/CHEM//INDIA/UNK/NERV/-/ACD//QUEBEC/35VPT126372/A/ACD//SIERRA/240929ZNOV2004//TANGO/URBAN/WOODS//YANKEE/133DGT/1KPH//ZULU/N/-12C/8/0/0//GENTEXT/NBCINFO/H-HAZARD:3 ONLY TEMPERATURE AND HUMIDITY ARE MEASURED//

Sensor log (client)
[27] (11-24-2004 09:26:52) : Sensor 1 - GID-3 (Chemical Detector) -> <START ALARM> Hazard level 3 (H-mode = 3.0000)
[28] (11-24-2004 09:27:15) : Sensor 1 - GID-3 (Chemical Detector) -> <ALARM OFF>

Sensor log (central)
[26] (11-24-2004 09:29:55) : Sensor 1 - GID-3 (CWA Detector) -> <***ALARM***>
[27] (11-24-2004 09:29:55) : Sensor 1 - GID-3 (CWA Detector) -> <START ALARM> Hazard level 3 (H-mode = 3.0000)
[28] (11-24-2004 09:30:14) : Sensor 1 - GID-3 (CWA Detector) -> <ALARM OFF>
[29] (11-24-2004 09:34:06) : Sensor 1 - GID-3 (CWA Detector) -> ALARM ACKNOWLEDGED

GPS (client)
Last fix:
[2780] (11-24-2004 08:34:17) : Sensor 5 - Acutime 2000 (GPS) -> Package 0x84:: Lat: 1.21683rad > Lot: 0.52206rad > Alt: 111m > Clock Bias: -58282m > Time Fix: 286566s (N69 43 09.227 - E029 54 43.432)

GID-3 (client)
[5719] (11-24-2004 09:26:53) : Sensor 1 - GID-3 (Chemical Detector) -> Mode: G > Code: {1310 60} > Mob: 2390 1468 1578 > Amp: 32 0 0 > Stat: RUN SAMPLING > Haz: 1
[5721] (11-24-2004 09:26:55) : Sensor 1 - GID-3 (Chemical Detector) -> Mode: H > Code: {1310 60} > Mob: 2059 952 1469 > Amp: 82 0 0 > Stat: RUN SAMPLING > Haz: 3
[5730] (11-24-2004 09:27:04) : Sensor 1 - GID-3 (Chemical Detector) -> Mode: G > Code: {2310 61} > Mob: 2388 1450 1581 > Amp: 49 0 0 > Stat: RUN SAMPLING > Haz: 2
[5731] (11-24-2004 09:27:04) : Sensor 1 - GID-3 (Chemical Detector) -> Mode: H > Code: {2310 61} > Mob: 2057 955 1468 > Amp: 81 0 0 > Stat: RUN SAMPLING > Haz: 3

GID-3 (central)

[3106] (11-24-2004 09:29:55) : Sensor 1 - GID-3 (CWA Detector) -> Mode: G > Code: > Mob: 0 0 0 > Amp: 0 0 0 > Stat: > Haz: 1
[3107] (11-24-2004 09:29:55) : Sensor 1 - GID-3 (CWA Detector) -> Mode: H > Code: > Mob: 0 0 0 > Amp: 0 0 0 > Stat: > Haz: 3
[3118] (11-24-2004 09:30:14) : Sensor 1 - GID-3 (CWA Detector) -> Mode: G > Code: > Mob: 0 0 0 > Amp: 0 0 0 > Stat: > Haz: 0
[3119] (11-24-2004 09:30:14) : Sensor 1 - GID-3 (CWA Detector) -> Mode: H > Code: > Mob: 0 0 0 > Amp: 0 0 0 > Stat: > Haz: 0

Windsonic (client)

[5717] (11-24-2004 09:26:50) : Sensor 3 - WindSonic (Wind Detector) -> Wind direction: 134 > Wind speed: 1.00
[5726] (11-24-2004 09:27:00) : Sensor 3 - WindSonic (Wind Detector) -> Wind direction: 130 > Wind speed: 1.00

Windsonic (central)

[3101] (11-24-2004 09:29:43) : Sensor 3 - WindSonic (Wind Detector) -> Wind direction: 133 > Wind speed: 1.00
[3111] (11-24-2004 09:30:05) : Sensor 3 - WindSonic (Wind Detector) -> Wind direction: 130 > Wind speed: 1.00

MTO (client)

[5725] (11-24-2004 09:26:58) : Sensor 4 - MTO (Temperature & Humidity) -> Temperature: -12.9 > Humidity: 87.5

MTO (central)

[3103] (11-24-2004 09:29:49) : Sensor 4 - MTO (Temperature & Humidity) -> Temperature: -12.9 > Humidity: 87.5
[3109] (11-24-2004 09:30:00) : Sensor 4 - MTO (Temperature & Humidity) -> Temperature: 0.0 > Humidity: 0.0

Multiwarn II (client)

[5712] (11-24-2004 09:26:43) : Sensor 0 - Multiwarn II -> Values: CH4 0.00 > O2 20.90 > NH3 0.00 > SO2 0.00

Automess (client)

[5723] (11-24-2004 09:26:58) : Sensor 2 - Gamma Probe (Nuclear Detector) -> Avgerage dose: 0.0574 > Maximum dose: 0.5737 > Interval: 000A > Number: 02C1 > Status: 0008