二〇二〇年美英加澳化學兵部隊譯介
--利用網路作業抑制CBRN與TIC外釋

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提要

一、利用網路作業(Network-Enabled Operations, NEO)，結合空中平台進行除污作業，可以將除污作業轉換成一種主動出擊的工具(先期制止)。

二、化學兵部隊必須善加利用網狀化作戰(Network-Centric Warfare, NCW)、整合感測器與軟體及遙控投射系統，以便先期籌劃發起主動制止污染的擴散。

三、本文引述著重美國陸軍化學兵期刊(Army Chemical Review)所刊載的新作法與新觀念，作為我核生化作戰整備與未來發展之參考。

壹、前言

美軍化學首席Stanley H. Lillie准將認為“戰場指揮官不僅只是需要我們成為應變部隊”(註1)。軍事指揮通資系統是在歷次戰爭不斷演化發展起來的，是將軍隊指揮體系從上到下緊密相聯的關鍵。軍事指揮通資系統是一項人-機系統，它以軍事科學為基礎，以軍事指揮體系為架構，以指揮官為核心，以現有的各類通資技術裝備，將各種指揮管制手段與指揮人員相結合。藉由高度自動化的情報蒐集、訊息傳遞與處理，使得指揮官的決策效率大幅提升，同時能夠將部隊戰力發揮到淋漓盡致。

二次世界大戰以來，隨著大規模毀滅性武器與電子計算機為核心的通資技術的出現，引發了近代科學史上的第三次技術革命。現代社會逐步走向資訊化時代，戰爭也開始進入了以高科技為基礎的資訊戰時代，也就是大規模毀滅性武器威懾條件下的高科技資訊化戰爭。在這種條件下，複雜的武裝力量、多樣化的作戰方式、廣闊的作戰空間、

註1 Chief of Chemical, “Moving our Corps Into the 21st Century” Army Chemical Review, April 2004, p. 7.

戰爭的不確定性增大、部隊機動迅速、戰場攻防轉換頻繁且劇烈、各種情報訊息量激增...，產生了許多新的情況和問題，因而對作戰指揮管制的時效性、準確性、靈活性等諸方面都有了更高的需求。例如：戰場情報的訊息量激增，則要求作戰指揮管制系統能對多種戰場情報進行快速分析與整合；作戰力量組成複雜，則需要作戰指揮管制系統能使多兵種聯合作戰密切協同與配合；高科技武器裝備增加，則必須能夠精確地使用與控制。由此可知，現代戰場中指揮官對部隊的指揮管制難度明顯增加。

為了使指揮官能根據戰場態勢作出快速反應、準確判斷、果斷決策，並能得心應手地指揮管制部隊與武器裝備，將戰力發揮至極致，若僅靠傳統的組織和指揮手段將難以勝任。所以必須發展以通資網路為核心的指管系統，使其成為指揮官用兵藝術的延伸，協助指揮官完成戰場情報蒐集處理、擬定行動方案、下達作戰命令、運用各類武器裝備、以及過去人工作業難以完成的戰場管理。

由過去歷史來看，除污已經被視為一種防禦方法，在戰場上一般是部隊防護的部份。隨著化學、生物、放射線與核子(CBRN)感測器的發展與獲得，以及空中載台執行除污技術的進步，預計於2020年與網路作業(Network-Enabled Operations, NEO)結合，即可將被動除污作業轉換成一種主動出擊的工具，達到先期防制的目的。這對於作戰與國土防衛將可明顯精進，美國陸軍化學兵在聯合發起(joint initiative)中也將扮演重要的角色。

在作戰系統中將除污作業整合至防禦方法中，化學兵將扮演領導者的角色。未來的除污作業所望結果必須能夠即時抑制CBRN釋放。為了實現此一目標，化學兵部隊必須善加利用網狀化作戰(Network-Centric Warfare, NCW)、感測器與整合軟體以及遙控投射系統，以便籌劃主動發起先期防制污染擴散的能力。“在贏得國家戰爭與協助聯邦、州郡及當地政府保護國土政策中，我們提供給戰士的CBRN防禦能力，是最基本的(註2)。”本篇文章將探究化學兵部隊(在CBRN防禦中的領導者)如何發展主動進階的能力，以提供聯軍戰士與國土防衛者使用。

貳、本文

註 2　Ibid

In many regions where American, British, Canadian, and Australian (ABCA) countries are likely to operate, an increase in CBRN personal-protective equipment (PPE) levels corresponds with a marked decrease in individual performance to such a degree that a “survive-to-evacuate” policy prevails. This is due to the difficulties of PPE use in equatorial environments with high temperatures or high humidity. To reduce the risk from CBRN and toxic industrial chemicals (TIC)/toxic industrial material (TIM) contamination, ABCA countries are on the cusp of having the ability to use interdiction platforms to reduce the effectiveness of CBRN and TIC/TIM releases.

在美國、英國、加拿大與澳洲等許多地方，皆有可能須要執行CBRN防護作業，但是CBRN個人防護裝備(PPE)等級的提升將造成個人執行首要政策“活著撤離(survive-to-evacuate)”的能力明顯降低，主要是因為在高溫或高濕度的環境中，使用個人防護裝備是痛苦的。為了降低CBRN與毒性工業化學(TIC)/毒性工業物質(TIM)的污染擴散風險，美、英、加、澳等先進國家具有頂尖的能力，它們是藉由使用消除平台，以降低CBRN與毒性工業化學(TIC)/毒性工業物質(TIM)外釋的效應。

The current principles of decontamination-perform as soon as possible, use only when necessary, perform as far forward as possible, and apply by priority are defensive in nature and concede opportunities to the enemy. The enemy carries out an attack, and we respond with defensive operations. The way forward is to take technological advances and shape them to produce a desired outcome. We still need traditional decontamination techniques; however, the need will be reduced due to heightened offensive decontamination capabilities.

目前的除污原則-「儘快執行」、「僅在必須時使用」、「儘可能朝較遠前方執行」、及「依據優先性來運用」-這些在本質上是一種被動式防禦，而且也為敵人留下運用空間。也就是說，敵人完成化學攻擊後，我們再以被動防禦的作業方式回應。未來的發展則是利用先進的科技技術，將化災現場塑造成我們所希望得到的結果。但是我們仍然須有傳統的除污技術；藉由主動、即時性的除污(避免污染擴散)能力的增強，降低傳統除污的作業需求。

1、Force Structure

Australia, along with fellow ABCA countries, is planning the structure of future defensive forces. All of these countries are moving along similar paths to create new force structures by 2020. In this area, our greatest challenge is keeping up with ever-changing technological improvements. The major reorganization of Chemical units, including the development of multicapable Chemical companies, will enhance the support available to the combatant commander by consolidating functions and simplifying unit structures.

一、武力結構：

身為ABCA的夥伴國之一的澳洲正在計畫未來的防禦武力結構。這些國家(ABCA)都是朝著相同的方向前進，也就是要在2020年的時候創造出新的武力結構。在這領域中，我們最大的挑戰就是要趕上持續進步的網路技術。澳洲化學兵部隊的主要組織重組包括多功能化學兵連的發展，將藉由一致的功能與簡化的單位結構，來強化對戰場指揮官的支援能力。

Australia is embracing the future joint operating concept (FJOC), which describes how the Australian Defense Force (ADF) will fight. The NCW is an integrating and supporting concept designed to organize the ADF using modern information technology that links commanders directly to sensoring equipment and weapons systems to allow real-time visibility. NCW is a tool that can contribute significantly to producing a warfighting advantage.

澳洲正利用未來聯合作戰的概念(Future Joint Operating Concept, FJOC)，來描述澳洲防禦武力(ADF)將如何作戰。網狀化作戰(NCW)是一個整合與支援的概念，利用它來組織防禦武力，使用現代化資訊科技，直接將指揮官與感測裝置以及武器系統連結起來，如此便能獲得即時的戰場景象。對於創造作戰優勢而言，網狀化作戰的確是一項有顯著貢獻的工具(註3)。

2、Network-Enabled Operations

NEO forms part of the NCW concept. The Australian document that outlines these plans is Force 2020. This document outlines the need to transition from platform-centric operations to NEO. Force 2020 goes on to explain how NEO derives power from effectively linking organizational elements to conduct warfare operations more effectively. The NEO concept treats platforms as “nodes” in a network. Since all

註 3 Andrew Hetherington, “NCW－The Future is Here,” Australian Army, <http://www.defence.gov.au/news/armynews/editions/1137/Default.htm>, accessed on 25 July 2006.

elements of the network are securely connected, personnel can collect, share, and access information to create a common, real-time battle space picture across all components and services. This allows for a greater level of situational awareness, coordination, and offensive potential.

二、利用網路作業(NEO)：

藉由網路作業(NEO)形成網狀化作戰(NCW)的部份概念。澳洲在“2020部隊”的文件中勾勒出這些計畫的輪廓(註4)。此文件描繪出由中心作業平台轉換至網路作業(NEO)的需求。“2020部隊”持續解釋網路作業(NEO)如何能夠從有效地連結組織單元中獲得力量，使其能更有效地執行戰場作業。網路作業(NEO)的概念是將現有的作業平台當作是網路中的“節點(nodes)”，由於網路可以將所有單元安全地連結起來，如此人員便可以收集、分享並接受資訊，透過所有組成與服務，創造出一個共通、即時的戰場空間圖像。這可以使更多層級瞭解即時景況，並提供協調與攻擊的潛能。

A desired outcome for using NEO is a common and enhanced battle space awareness that delivers a maximum combat effect. The maximum combat effect for the Chemical Corps is the interdiction of CBRN release plumes to neutralize agent effects. Traditionally, the focus of decontamination operations has been on liquid contamination, but we should be exploring the nontraditional gap areas. One such gap area worth exploring is the aerial release of decontaminants to neutralize vapor clouds

使用網路作業(NEO)所希望得到的結果是一個共通且強化的戰場空間警覺，也就是傳遞最大的戰場效應。對於化學兵部隊而言，最大的戰場效應是抑制CBRN的外釋，使戰劑無法發揮效用。傳統的除污作業是將焦點集中在液態污染，但是我們應該探究非傳統與傳統間的間隙領域，其中一項值得探究的領域就是在空中釋放除污物質，以中和蒸氣雲。

The NEO concept is a tiered system of grids-sensor, command and control (C2), and engagement-with specific purposes:

- ●A sensor grid collates real-time information from every type of sensor, from satellites to Soldiers, to create a shared picture of battlefield conditions. The ability to connect to this grid will emerge as the primary source of combat power.

註 4 “Force 2020,” <http://www.defence.gov.au/publications.cfm>,accessed on 25 July 2006.

- ●A C2 grid collates, analyzes, and makes rapid maneuver and target allocation decisions based on the battlefield picture.
- ●An engagement grid executes the decisions of the C2 grid, using the best "shooter" regardless of the equipment designated to deal with the target.

網路作業(NEO)的概念是階梯層次的網格(grids)系統-感測器、指揮與管制(C2)與交戰(engagement)-以及特殊的目的：

（一）感測器網格收集整理各種型態感測器所獲得的資訊，再由衛星傳至士兵，創造出一個共享的戰場空間圖像。連結至網格的能力也就是戰力的主要來源。

（二）根據戰場圖像、C2網格整理、分析並做出快速機動與標靶分配的決定。

（三）交戰網格則是使用最好的"射擊手(shooter)"處理標靶，來執行C2網格的決定(註5)。

3、Sensor Grid

The Chemical Corps should develop the sensor grid as a priority. This does not mean an increase in the number of sensors, but rather an upgrade in their ability to communicate with the C2 grid. Each sensor should have the ability to link into the system as needed. This may mean a "drill down" ability where the main Chemical Corps C2 grid (such as the hazard prediction and assessment capability [HPAC]) automatically processes sensor information as it moves further into an area. The Australian HPAC does this by linking into meteorological sensors around the world. The GID-3™ also has a remote sensing capability that links back to a base station. The Chemical Corps needs unit-based sensors to link into the C2 grid.

三、感測器網格：

化學兵部隊應該優先發展感測器網格。這並不意味著必須增加感測器的數量，而是要提升與C2網格的連結能力。每個感測器都應該且必須有能力連結至此系統。這可以說是一種"播種"能力，在那裡，主要的化學兵部隊C2網格(諸如危害預測與評估能力HPAC)自動處理進入此區域的感測器資訊(註6)。澳洲的HPAC是藉由連結

註 5　Ibid.

註 6　The HPAC is a hazard prediction system with an atmosphericdispersion model as its core.

至世界上的氣象感測器來完成。GID-3TM也有連回基地台的遙測能力(註7)。化學兵部隊需要以單位為基礎的感測器連結至C2網格。

Along with the development of unmanned aerial vehicles (UAVs), the Chemical Corps should focus on the development of UAV CBRN sensors. Current UAV development focuses on imagery and striking platforms that fly high and fast. The UAV CBRN sensor platform will fly slow and low. The Corps should be involved with UAV CBRN sensors now, as they will become more critical to future operations.

隨著空中無人載具(UAVs)的發展，化學兵部隊應該將聚焦於UAV CBRN感測器的發展。目前UAV的發展是將焦點集中在飛的高且快的影像與打擊平台。而UAV CBRN感測器平台需要的將是飛的慢且低。這些部隊應該將UAV CBRN感測器納入，因為它們對未來作戰將變的更形重要。

Doctrine that addresses the employment of sensors in an NEO environment needs to be developed now. It must be linked to the new CBRN doctrinal concept, which is framed in the areas of sense, shape, shield, and sustain. Forward thinking is required for this developing doctrine, which would include sensor sighting, information transfers, decision-making processes within the C2 grid, and the employment of relevant Corps engagement grid resources (such as UAVs, unmanned ground vehicles [UGVs], and air platform-based decontamination assets).

現在需要發展感測器在網路作業環境中的運用理論。它必須能夠連結至新的CBRN學說的概念中，也就是在早期監偵(sense)、全維布局(shape)、全面防護(shield)與綿密維持(sustain) (註8)的架構中。對於此理論的發展是須要有前瞻性的思考，而前瞻性的思考則包括感測器的範圍、資訊傳輸、C2網格內的決心策定程序以及相關

註 7 The GID-3 is an automatic chemical-agent detector and alarm system manufactured by Smith Detectionc. It warns of the presence of chemical-agent vapor in the surrounding air.

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註 8 早期監偵(sense)：透過偵檢(測)、識別與量化 CBRN 危害，能夠不斷提供 CBRN 威脅的能力；全維佈局(shape)：透過蒐集、整合 CBRN 危害訊息，提供描述、表示 CBRN 危害特徵的能力；全面防護(shield)：也就是防止或減少暴露，運用預防手段減輕因暴露所產生的負面生理效應，以及對重要裝備的防護能力；綿密維持(sustain)：透過消除與醫療救援，能夠使作戰力量持續的能力。

部隊交戰網格資源的運用(例如：UAVs、無人地面載具[UGVs]，也就是以除污設施為基礎的空中平台)。

4、Command and Control Grid

C2 grid networking is broken down into a two-phase response. Phase 1 calls for the incorporation of current warning and reporting systems and the enhanced C2 technology needed to incorporate air platforms into an interdiction plan. Using HPAC as an example, the upgraded system will display the sensor grid information, the current location, and the state-of-readiness status of all chemical engagement grid platforms. Upon receipt of information from the sensor grid, the Chemical officer in the C2 grid plans the immediate plume interdiction and transfers the plan to the respective engagement sensors. These engagement sensors could include C-130 aircraft, UAVs, UGVs, or troops. Phase 2 involves an ongoing assessment of the long- and short-term threats and the identification of ground forces required to go to a higher level of PPE. This threat assessment is as relevant to homeland defense operations as it is to conventional warfighting operations. Phase 2 also includes the performance of ongoing response requirements.

四、指揮與管制網格：

C2網格網路可以分成兩階段(two-phase)回應。第一階段需要整合目前的警報系統與強化的C2技術(必須將空中平台整合至抑制污染擴散的計畫中)。使用HPAC就是一個例子，更新的系統將顯示感測器網格的資訊、目前位置、以及所有化學交戰網格平台的準備狀態。當化學軍官從感測器網格收到資訊時，便可在C2網格中立即完成抑制外釋的計畫，並將此計畫傳至個別的交戰感測器。這些交戰感測器包括了C-130運輸機、UAVs、UGVs或是部隊。第二階段則是持續評估長期與短期的威脅，以及鑑定地面部隊是否需要提升PPE等級。這與國土防衛作業的威脅評估與傳統作戰的評估方式相同，同時第二階段也包括持續進行應變的需要。

With the goal of using new technical advances to show the Corps’ early interdiction of a CBRN plume, the challenges of conducting successful sensor information transfers to airborne platforms is critical. A Northrop Grumman Corporation/Lockheed Martin Corporation industry group recently demonstrated success in high bandwidth communication transfer to and from air platforms. “In the demonstration, electronic signals generated by the [active, electronically steered array] AESA radar were used to transmit imagery data transmission to [the] L-3 Communications [Corporation] common data link [CDL] modems, at a speed of 274 megabits-per-second, twice and four times the basic common data CDL data rate. . . . This demonstration is part of the F/A-22 Non-Traditional Intelligence, Surveillance and Reconnaissance (NT-ISR) missions, considered for possible spiral application into F-22 and F-35 aircraft programs, allowing them to transmit and receive large, uncompressed data packages, such as synthetic aperture radar images and other data, within seconds."

使用新技術優勢來展示部隊早期抑制CBRN的威脅目標，最重要的挑戰是如何能夠成功地將感測器資訊傳給空運平台。Northrop Grumman公司/Lockheed Martin公司的工業小組最近成功地證明空中平台的高帶寬(high-bandwidth)通訊傳輸。"在這證明中，由主動、電子導引序列[Active Electronically Steered Array, AESA]雷達所產生的電子信號，可以用來傳輸影像資料，以每秒274MB的速度，是一般基本的數據連結[Common Data Link, CDL]速率的4倍，將其傳至L-3通訊[整合]一般數據連結[CDL]機中。此項證明是F/A-22非傳統情報、監視與偵察(NT-ISR)任務的一部份，考慮將其應用至F-22與F-35飛機的可能性，使得它們能夠於數秒內傳送與接收大量、未經壓縮的資料夾，例如人工製作的雷達影像與其他數據。(註9)"

The mentioned demonstration is one example of the ground-to-air data transfer capability available. This capability will allow the Chemical Corps C2 grid to transfer the required data to an engagement grid (which in this case is a C-130 aircraft from the 910th Airlift Wing) to interdict a CBRN release. The development and conceptual validity of the information transfer capability between the C2 grid and the 910th Airlift Wing platform should be considered urgent!

以上的證明僅是地對空數據傳輸能力的一個例子。這能力將使得化學兵部隊C2網格能夠傳輸需要的數據至一交戰網格(例如：C-130的910th機翼如圖1)去抑制CBRN的釋放。在C2網格與910th機翼平台間的資訊傳輸能力概念的有效性及其發展應該是較急迫的。

註 9 "Converting Aircraft for Broadband Data Transfer Capability," Defense Update, International Online Defense Magazine, <http://www.defense-update.com/features/du-1-06/aircraft-com.htm>, accessed on 14 July 2006.

圖1　C-130執行空中噴灑任務(註8)

The development of a Chemical Corps engagement grid component will diminish the threat through a network of interdiction platforms. "The vital importance of seaports of debarkation (SPODs) to U.S. power projection capability makes them an attractive target for a chemical biological (CB) attack. As such, SPODs in immature theaters are considered strategic centers of gravity requiring careful protection and commitment of resources to ensure that they are adequately protected and, if attacked, quickly restored to operation. The ability to defend SPODs against CB, toxic industrial chemical[s] (TIC), and toxic industrial material (TIM) attacks is an operational necessity for all unified combatant commands during power projection and force deployment operations."

化學兵部隊交戰網格組成的發展目的是要透過抑制平台網路，將污染擴散範圍減至最低。"卸載港口(SPODs)的生存性對於美軍的戰力投射能力而言是重要的，因此這些港口很容易成為生化攻擊的目標。SPODs的地位在設備不足的地區(immature theaters)中，被認為是需要小心保護的重要戰略中心，並投入資源以確保它們能夠受到適當的防護，萬一遭受攻擊，亦能快速重建。在戰力投射與武力部署作業期間，SPODs防禦抵抗生化戰劑、毒性工業化學以及毒性化學物質攻擊的能力，對於所有統一的戰場指揮而言是必要的。(註10)"

The development and advances in the sensor and C2 grids provide the opportunity to include force multipliers in the engagement grid. In particular, a main Chemical Corps weapon in the armory to interdict CBRN releases should be the aerial-spray capability of the 910th. Aerial-spray capability has historically been limited to the eradication of pests such as mosquitoes and beetles, but the capability of the 910th to

註 10　Victor Ellis, "Science and Technology in a Dynamic CBRN Landscape," Army Chemical Review, April 2004, p. 32.

perform wide-area decontamination operations is outside current Chemical Corps engagement grid assets.

感測器與C2網格的發展與進步，提供了遭遇網格中增大武力的可能。特別是在軍械庫中，主要抑制CBRN釋放的化學兵部隊武器，應該是910th的空中噴灑能力。歷史上的空中噴灑能力僅侷限在撲滅病蟲害，例如：蚊子及甲蟲，但是910th執行大面積的除污作業能力，目前卻被排除在化學兵部隊交戰網格設施之外。

The 910th Airlift Wing conducted limited trials in the 80s and 90s. These trials demonstrated the ability to deliver spray decontamination from aircraft.10 “From 1983 to 1993, the 910th Airlift Wing developed a one-of-a-kind [ultrahigh volume] UHV technique for the C-130 [Modular Aerial- Spray System] MASS to apply 250 [gallons per acre] gallons/acre or more with very little drift. From 1993 to 1997, they also conducted feasibility testing with the Joint Contact Point at Dugway Proving Grounds [sic] UT [sic] and demonstrated that the MASS in the UHV mode can evenly cover a 60-foot by 4,000-foot assault strip with 250 [gallons per acre] gal/ac [of] water using 2.5 sorties.”

在80與90年代，已經針對910th機翼進行有限度的測試。這些測試結果證明了由飛行器傳遞噴灑消除物質的能力(註11)。從1983年至1993年，910th空運機翼為C-130[模組化空中噴灑系統]發展出一種體積非常高[UHV]的技術MASS，每英畝(43560平方公尺)可噴灑250加侖以上，且僅有非常少的偏差。從1993年至1997年，它們也與Joint Contact Point at Dugway Providing Grounds [sic] UT [sic]一起執行可行性測試，並證明了MASS在UHV模式下，以2.5架次，每英畝噴灑250加侖的速率，甚至能夠掩蓋60英尺乘4000英尺遭污染的狹長跑道(註12)。

An October 1998 field test showed that a mild 1.25 percent bleach mixture delivered by the C-130 MASS UHV technique decontaminated 99.9 percent or more of a biological simulant on concrete and painted metal. In the target area, a 1,000-fold average reduction in bacterial contamination was exceeded. The development of aerial decontamination interdiction capability is moving to larger aircraft that can be A C-130 performs an aerial-spray mission. contracted at short notice to augment

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註 11 Youngstown-Warren Air Reserve Station, “Fact Sheets: Aerial Spray Mission,” <http://www.youngstown.afrc.af.mil/library/factsheets/ factsheet.asp?id=3413>, accessed on 14 July 2006.

註 12 Headquarters, U.S. Air Force Reserve Command, 910th Airlift Wing briefing notes.

July – December 2006 15 capability gaps. There is a need for more research on decontamination solutions and methods, particularly in radiological material.

1998年10月的野戰測試顯示，針對混凝土與塗漆金屬上的模擬生物毒劑，藉由C-130 MASS UHV技術遞送1.25%的溫和漂白劑混合液，可達成99.9%以上的除污率。在目標區內，減少平均超過1,000倍的細菌污染(註13)。對於除污溶液與除污方法而言則需要更多的研究，特別是針對輻射物質。

The Chemical Corps engagement grid should not end with traditional equipment and fixed-wing aircraft. The ability to use rotary-wing aircraft and UAVs to deliver decontamination solution should also be explored. For example, equipping the Schiebel Corporation next generation CAMCOPTERR S-100 tactical UAV (which has a 50-kilogram payload) with a decontamination dispersal system would allow a CBRN release to be remotely, safely, and quickly interdicted. Civil support teams would benefit from the augmentation of engagement grid resources (such as the 910th Airlift Wing) during periods of heightened threat levels.

化學兵部隊的交戰網格不應該隨著傳統設備與固定翼飛行器而結束。也應該要探究使用螺旋翼飛行器與UAVs遞送除污溶液的能力。例如：配備Schiebel公司所生產的下世代CAMCOPTER S-100戰術性UAV(50公斤的負載)具有除污噴灑系統，將能夠遙控、安全且迅速地抑制CBRN的外釋。在威脅等級提升期間，民間支援團隊也將可從交戰網格(910th 飛行翼)資源中獲益。

參、結語

在化災應援作業或是支援戰場指揮官作戰中，需要的是即時抑制CBRN的外釋，特別是在城鎮的環境中。由許多機構所研究的不同外釋模式所執行的結果，證明了在城鎮環境中CBRN的外釋將隨著不同型式的風產生複雜的效應。因此，未來的外釋處置模式應將焦點置於即時的想定，藉以說明外釋的毒劑將可能如何擴散以及我們要如何降低外釋的效應，其目的則是要減少作業人員與部隊防護等級提升的必要性。早期預警或在污染擴散初期即時消除，必可將威脅降至最低。

偵檢器是感測器的一部份，將用來偵檢外釋的CBRN戰劑或工業毒性化學物質。接著，將此偵檢資訊傳送到指揮部與抑制平台，進而

註 13　Ibid.

發展與執行抑制外釋計畫，啟動已部署的固定機翼、螺旋機翼與UAV平台。網狀化作戰(NCW)的好處就是能夠即時傳送資訊。一般的警報與報告延伸出後續的防護作為。固定與機動的感測器(包括UAVs)可以提供最初的污染確認與鑑定，並透過警報與報告系統將這些資訊傳遞至C2區域與抑制平台。在C2區域，化學軍官以獲得的資訊為基礎，發展並協調污染抑制計畫。接著，諸如910th機翼C-130s的抑制平台與化學兵部隊的UAVs，基於此計畫來執行污染抑制策略。這將可看到910th從適當的高度完成除污作業，螺旋翼飛行器負責處理整體的污染地點，而UAVs則負責處理熱區任務。整體目標包括了立即消除初期釋放的毒劑與抑制毒劑擴散。

戰士不僅只是需要化學兵部隊成為應變武力，由NEO與階梯式的網格系統，將可看到從偵檢到精確地抑制CBRN或TIC/TIM的外釋，傳輸過程中毫無任何間隙存在。由這種傳輸過程就可看出未來武力將頻繁使用遙控技術，特別是UAVs與UGVs的使用(包括了小型與微型系統)。現在就可將空中噴灑能力引入交戰網格的資源中，結合910th飛行翼，使得C2網格能夠分享即時影像並管制CBRN外釋處理的進度。這些都將成為未來化學兵部隊邁向更有效率的基礎。抑制CBRN或TIC/TIM的外釋，將對部隊中的戰士以及應變指揮官有貢獻，使得化學兵部隊不再只是應變部隊，而是能夠主動發起先期制止污染擴散的戰鬥支援部隊。

在軍事需求與科學技術進步的驅動下，指揮、管制、通訊、資訊、情報、監視與偵察(C4ISR)系統歷經了初始創建、全面發展、更新改造以及趨於成熟等發展階段，表現出一體化的本質特徵。由最近幾場高技術局部戰爭的結果顯示，為了能夠適應新的軍事變革發展並滿足網狀化作戰的需要，除了將化學、生物、放射線與核子(CBRN)設備現代化之外，必須重視並加強與軍事指揮管制系統鏈結的研究和建設。世界各國紛紛投入大量的人力、物力與財力來研發軍事指揮資訊網路系統，以利在未來戰爭中獲得主動優勢。在這種情勢下，我們必須充分認識與理解C4ISR一體化的本質與發展趨勢，並積極將此概念運用至化學兵部隊，方能塑造我們所能掌握的核生化戰場。