化生放核轉型願景與策略（譯）

CBRN Preparedness Transformation Vision & Strategy

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前言

本文旨在以當前之科技水準，迅速使化生放核及戰況掌握達成轉型，所需之願景與策略。本文所建議之願景及策略，是將若干偵檢技術與建制通信架構相連結，快速成為轉型所需之載台。整合的內建偵檢技術是經過篩選，而且在大部分的狀況下，應由系統操作人員共同參與。欲將彼此不相關的化生放核裝備轉型，成為狀況掌控體系的一部份，必須經過詳細的分析。特定裝備之整合，更須經過驗證，方能確定可達到狀況掌控的願景。

要求條件

在面對具備化生放核能力的敵人時，狀況掌控、弱點評估、危險判斷等，乃是指揮官的「重要情報需求」(commander's critical information requirement, CCIR)的一部分。當發生化生放核事件時，領導人員必須能精準地掌握資訊，而且資訊必須能經常更新，據以作進一步之狀況判斷。任何化生放核事件影響所及，可以在作戰空間下風處數十公里，一條極寬的區域，長達數小時之久。目前化生放核專業部隊的狀況掌控，基本上是以各級部隊的手持裝備為主。引進整合性自動化偵檢科技，是改善當前狀況掌控的合理可行方法。

偵檢

目前美軍化生放核事件，在單位層級使用電子與非電子裝備。非電子裝備主在滿足個人及小組之生存所需(如液體污染偵檢、高濃度毒氣偵測、個人消除等)。電子偵檢裝備則提供立即危險警告。重要的化生放核偵檢資訊由單位裝備操作人員首先獲得，然後交由連隊向上級指揮系統報告。從操作人員階層獲得的資訊，將會有更新的裝備予以驗證。但不幸的，所有增加的裝備都需要操作人員不斷注意，當偵檢器發出警訊，操作人員首先要完成個人的防護動作，如戴上防毒面具、警告鄰兵、穿著防護服等，然後才依照指揮體系逐級報告。偵檢數據通常由裝備操作人員以文電，或直接以其編裝的 C4ISR 系統透過語音發送。發布化生放核警報並定期予以更新，雖為一項重要任務，但其優先順序常為其他作戰任務所干擾，當化生放核偵檢器與 C4ISR 系統之間聯繫不暢通時，此一問題尤其嚴重。

如何改進狀況掌控？

重要的化生放核偵檢數據最好能透過 C4ISR 系統自動發送，而且能將偵檢器內建於載台內最有價值。由於現行偵檢器多為手持式裝備，因此作以上改進並不會造成太多困難。根據一項化生放核作戰想定分析及戰力需求的檢討報告顯示，某些偵檢器可以直接與現行裝備及載台相整合。當然有些則否。若干只需要低度維修的化生放核裝備，最適合有系統地予以模組化，成為載台的次系統。

轉型之方向：

轉型的真意不在於單純的自動化及現地偵檢的價值而已，而是在於載台內就能持續不斷，自動處理並報告所有偵檢資料。自動化報告雖然是重要而且是必備的能力，但是報告要能顯示未受污染區，指示危險程度之降低，及通行之限制。顯示化生防核安全區資料，有助於真正瞭解戰場上實際戰況發展。在現有載台的 C4I 系統上加裝化生放核裝備有其必要，而且兩者整合後必須具備以數據傳輸的功能。這些資料經過解讀後的重要資訊，即時提供載台操作者及其上一指揮層級。每一載台都能掌控一定範圍的化生放核戰況，與現行以人工方式建立的狀況掌控不可同日而語。從載台產生的資訊流，可以讓指揮階層即時掌握化生放核狀況，並依照其作戰需求定期更新其情報需求。

目前使用的「悍馬」系列車輛最適合作為以上建議的轉型載台。當車輛在基地廠庫或工廠中進行翻修或最終改裝時，最適宜從事上述改裝。外觀上，改裝後的車輛看不出變化。目前各部隊擁有甚多悍馬車，而且不少車輛已裝置有制式偵檢器，但是因狀況、車型及單位之不同，裝置的偵檢器亦不盡相同。

一、目前裝置之偵檢器特性為：

(一)主在警告作業人員重大危險狀況。

(二)以目視監測，人工作業。

(三)偵測資料透過現有 C4I 系統，以人工數據輸入或語音傳送。

(四)需要操作手人工啟動偵檢及報告程序。

(五)需要作業人員專業判斷。

(六)須與載台之 C4ISR 系統無直接連結。

二、將偵檢器內建於平台，並與資訊系統連接後：

(一)對作業人員提出危險警告，並自動向上級報告。

(二)透過 C4ISR 系統一面報告，一面持續偵檢。

(三)從現行 C4ISR 系統自動以數據回報偵檢結果。

(四)自動啟動初步及後續偵檢與報告程序。

(五)附掛於現行「重要資訊流」(如「友軍位置追蹤系統」)，利用原載台之 C4ISR 系統，傳送化生放核資訊。

(六)增加生化樣品收集口，如在引擎進氣口加裝樣品收集模組。

(七)建立全軍一致之共同偵檢基準。

三、可優先整合之化生放核偵檢器：

根據經驗，初期可整合於平台的化生放核裝備為：

(一)車內外氣態化學戰劑(CWA)偵檢器。

(二)特定或經改良之「工業化學毒氣」(TIC)偵檢器。

(三)γ射線偵檢器。

(四)氣態及微粒之生物戰劑辨識收集器。

(五)毒氣樣品收集及增壓器(CWA 及 TIC)。

(六)一種可以自動改變顏色，顯示遭受液態化學戰劑污染的表面，甚至分層自動消除污染的新型裝備塗料，亦可納入考慮。

新科技展示及實驗程序，可以提供不同部門對初步選定項目，進行評估並提供改進意見。針對化生放核之相關項目，應提供啟用的部隊及軍種實際驗證：

(一)考量現今敵人能力，評估於載台內建即時偵檢，實施聯合戰鬥實驗。此一實驗結果可據以建立遂行聯合作戰時各軍種之平衡需求。

(二)決定軍種對化生放核之需求、應於載台內建何種偵檢能力、初步及後續資料如何更新等問題，據以制定優先順序、所需之聯合作戰構想研擬與實驗。

(三)檢討現有及計畫中傳輸化生放核資料之 C4ISR 系統之適用性。其中包括檢討現行系統及考量之設施，可以傳送多少資訊，並判斷狀況嚴重性增高時，能容納多少額外資訊。

(四)國防部之作需檢討及必要文件。

(五)可於短期或中期獲得之偵檢科技檢討。

(六)對可能被選用作為偵檢整合之現行科技採購之檢討。

四、載台內建化生放核次系統可能產生之問題：

(一)將化生放核偵檢器內建於平台作為轉型願景，牽涉國防部及軍種間之共同協議。

(二)建立載台內建偵檢器與 C4ISR 整合之基準，以確保全軍化生放核戰力之共通性。

(三)由國防部草擬載台內建化生放核次系統之基準。

結語

自動化及現有化生放核系統整合於載台內，可以持續不斷提供化生放核狀況掌控，有助於強化未來在幅員遼闊地區的作戰能力。某些選定之化生放核偵檢器整合到載台內，加上 C4ISR 系統的幫助，可以使化生放核之狀況掌控能力大幅躍升。現行之偵檢系統若不增加一些介面，將無法與現行 C4ISR 系統構聯，但若能完成，將使整個偵檢能力進入另一個新境界，對追求網路戰戰力有莫大助益。新的願景可以使化生放核的狀況掌控得到真正的轉型，並且具備足夠的能力因應所有化生放核戰況。

CBRN Preparedness Transformation Vision and Strategy

By Lieutenant Colonel James Demyanovich

This article describes a vision and strategy for the military services to achieve near-term, transformational capabilities in chemical, biological, radiological, and nuclear (CBRN) situational awareness based on today's technologies. This vision and strategy are proposed by the author using selective CBRN sensor technologies, linked to organic communications architectures, and inserted into near-term military systems (platforms). This technology insertion and integration would be selective and, in most cases, transparent to system operators. Only through analyses (not attempted here) can this vision be crafted into a feasible approach that transforms diverse and disconnected elements of CBRN defense equipment into a network of situational awareness. Follow-on, robust systems analyses and experimentation may shed light on specific material solutions and approaches that can provide our military with the integrated and efficient CBRN situational awareness it has long sought (provided as architecture built into military platforms).

An overarching premise: In an operational environment under a credible CBRN threat, situational awareness, vulnerability assessment, and hazard estimation are clearly commander's critical information requirements (CCIRs). Leaders need accurate and understandable information on CBRN incidents. And this information must be constantly updated and transmitted in situational assessments. CBRN events can affect large swaths of operational space and impact forces for hours and at distances up to tens of kilometers downwind. Current methods of equipping forces for CBRN situational awareness have focused on providing handheld equipment to individual operators and units. The incorporation of a selected set of automated and integrated CBRN sensor technologies into platforms is a step in transforming military situational awareness with potentially near-term, achievable benefits across the force.

How do U.S. forces sense CBRN events? At the unit level, CBRN equipment is electronic and nonelectronic. Nonelectronic items are typically single-use items meant for critical individual and small-group survival tasks (such as liquid contamination detection, highly toxic vapor detection, or individual decontamination). Most electronic CBRN sensors provide information on CBRN hazards that are immediately dangerous. Critical CBRN detection information is first directed to the unit CBRN equipment operators and then to unit leadership to brief higher commands. This user level information focus has incrementally helped equipment operators with new end items of equipment that provide added CBRN capability.

Unfortunately, every added piece of equipment requires user attention. When CBRN sensors alert operators to positive detections, the operators must focus first on survival actions such as donning a protective mask, warning others, and donning protective suits. Later, the operators report sensor findings through command channels. Sharing CBRN sensor data and updating it regularly becomes a significant task, often overcome by other operational priorities. This is particularly problematic due to the lack of connectivity between most CBRN sensors and military command, control, communications, computers, and intelligence (C4I) systems that are often within arm's reach of one another on military platforms. Equipment operators often interpret and report CBRN sensor readings by typing text reports or relaying voice messages using their organic C4I systems.

How can CBRN situational awareness be significantly improved? Transferring critical CBRN sensor data automatically into C4I systems is the key. The proposed, transformational approach equips military platforms with a set of high-value CBRN awareness sensors as built-in features "behind the dashboard." Such features will displace some existing CBRN sensors (following a required capabilities reevaluation). This displacement is possible because many of the CBRN sensors dedicated to area warning are fielded as handheld equipment. Following a realistic, CBRN operational scenario analysis and capability requirements review, selected CBRN sensors could be recommended for platform integration. These sensor capabilities may or may not use existing CBRN sensors rugged and reliable enough to be integrated directly into platforms as subsystems. Appropriate, low-maintenance CBRN technologies could be modularized and systematically applied to a myriad of platforms at the subsystem level.

What is transformational about this approach? The real change is not just the value of automatic and local CBRN sensing, but the process of sensing and reporting data consistently and automatically at and from the platform level. Automating the CBRN reporting task is a vital and needed capability, but automatic reporting requires negative detection reports that also indicate hazard reductions and passage restrictions. Adding such reports for areas free of CBRN hazards would significantly enhance the operational understanding of evolving CBRN events and provide a more accurate ground truth. CBRN technology connectivity to existing platform level C4I systems is required. This C4I integration would be included to distribute CBRN data digitally. The availability and interpretation of CBRN data would then provide significant information to platform operators and higher command echelons. Each platform would give individual elements a larger web of friendly CBRN situational awareness. This totally contrasts with the low level of CBRN awareness created using manually generated text or voice reports. The platform level CBRN data streams and updates would provide command echelons with required, regularly updated CBRN CCIR for operational forces to provide a better understanding of CBRN events.

For example, the current inventory of high-mobility, multipurpose, wheeled vehicles (HMMWVs) in use could be transformed under this proposal. The changes could occur at the depots or factories during recapitalization or as modifications during the construction of new end items for fielding. Outwardly, there would be little indication of significant changes to the platform. Today, many military units are equipped with HMMWVs, and some transport organic CBRN sensors. However, the use of CBRN equipment while traveling in a HMMWV varies significantly from situation to situation, vehicle to vehicle, and unit to unit.

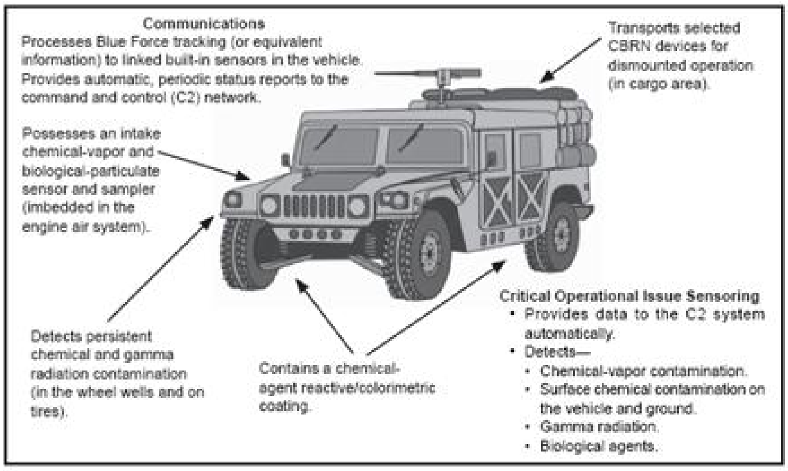
Current CBRN sensors—

- Are used primarily to warn operators of grave danger.
- Are manually employed and visually monitored.
- Depict CBRN detection events that must be reported with existing C4I systems (typed digital reports or voice reports).
- Require that the operator direct tasks for initial CBRN detection reporting and periodic situation updates through typed digital reports or verbal reporting on C4I systems.
- Operate at the discretion of equipment operators.
- Are mostly disconnected from platform C4I systems.

With sensor integration and data connectivity, CBRN sensors and capabilities built into platforms can—

- Warn operators of grave danger and automatically notify higher commands.
- Automatically operate when platform C4I systems report sensor information and alerts.
- Automatically report CBRN detection events as digital data on existing C4I systems (in standard report formats) with operators adding information as needed.
- Provide initial CBRN detection reporting and periodic situation updates based on algorithms, without operator direct actions (unless directed to do so, using available C4I systems).
- Exploit platform C4I systems to provide CBRN sensor data using existing critical data streams (such as Blue Force tracking) to provide CBRN event information as CCIR (in addition to friendly force locations).
- Provide added features, such as chemical-biological sample collection ports (added as a vehicle power plant air intake) as sample collector modules.
- Establish a common baseline of CBRN sensing capabilities across military services to ensure common and uniform operations.

What should a priority set of integrated CBRN sensors consist of? Based on experience, an initial set of



Future HMMWV with added CBRN capabilities

CBRN equipment for integration at the platform level may include—

- The detection of chemical warfare agent (CWA) in the vapor phase from ambient and crew compartment air.
- Selected or tailorable toxic industrial chemical (TIC) gas sensors.
- Gamma radiation sensors.
- Aerosol, particulate biological-agent discrimination and collection equipment.
- Toxic-gas sample collection and accumulator (CWAs and TIC).

A new feature that is not currently in the military could include equipment coating as a replacement for current chemical agent-resistant coating. A new reactive coating would indicate, by a color change, the presence of liquid chemical-agent surface contamination and perhaps react with the agent destructively and delaminate to remove surface and penetrated contamination.

A possible technology experimentation and demonstration process could provide cross-community evaluation and refinement of an initial selection of CBRN technologies.

Parallel joint and service experimentation efforts should be initiated and could include, but are not limited to, CBRN technologies focused on—

- Joint warfighting experimentation that takes into consideration the value of near-real-time, platform level CBRN sensing, as compared to existing capabilities against threat scenarios. This would establish a balanced need for services operating as part of joint operations.
- Joint concept development and experimentation efforts that determine service needs and desires for platform level CBRN sensing, initial service desires for initial and periodic sensor data updates before and following CBRN events, and priority ranking.
- Current C4I systems, particularly when evaluating the suitability of existing and planned systems to transmit CBRN sensor data. This would include evaluating existing systems and available infrastructure capabilities to accommodate key CBRN data and estimating how much data could be accommodated during routine and surge CBRN events.
- Department of Defense (DOD) level requirement reviews and documentation (as needed).
- Science and technology reviews for available CBRN sensing technologies that might provide required user near- and mid-term capabilities and information.
- Acquisition program reviews of existing technologies that might be selectively harvested for sensor integration.

What are some challenges in a transformational CBRN sensor approach to platforms?

Programmatic challenges are indicated above and would include—

- Accepting built-in features as a transformational vision for CBRN capabilities involving collective agreements from DOD CBRN defense efforts and service level programs.
- Establishing an overarching CBRN sensor and C4I integration baseline for platform levels that will ensure DOD commonality of CBRN capabilities.
- Establishing a DOD draft, platform level, CBRN subsystem integration baseline.

Military operations are more dispersed over wide areas and can benefit from automating and integrating available CBRN preparedness enhancements to their platforms. These enhancements would provide consistent levels of continuous CBRN situational awareness. The integration of selected CBRN sensors at the platform level, with C4I integration incorporated, provides a leap ahead in CBRN situational awareness capabilities. Current CBRN sensing systems do not readily interface with C4I systems without fielding added C4I interface devices. The integration of CBRN sensing into platforms focused on C4I system connectivity provides a new level of CBRN sensing. U.S. Forces, with continued enhancement of net-centric operations, will benefit from this effort. This approach can truly transform CBRN situational awareness and provide our services with capabilities that allow for the best awareness of and response to CBRN operational conditions.

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