SURVEILLANCE & RECONNAISSANCE IN FUTURE CBRN OPERATIONS

Timely information is necessary for optimal response to Chemical, Biological, Radiological and Nuclear (CBRN) weapons on a battlefield. For this, CBRN Surveillance and Reconnaissance gathers intelligence about such weapons and the contaminated area by performing critical tasks on the battlefield. Rapid identification is required to take tactical decisions and to protect soldiers against CBRN hazards. The use of robotic vehicles and detectors will be force multipliers in CBRN reconnaissance in the future

By **COL (DR) RAM ATHAVALE**

The ongoing wars in Ukraine and Israel have shown that future battlefields will be hybrid asymmetric and use many emerging technologies. Future battlefield is going to be complex, with myriad weapon systems being employed. The concern for loss of life has led to increased use of automated systems. Chemical, Biological, Radiological and Nuclear (CBRN) weapons are the most feared ones and hence getting accurate and timely information for optimal response is necessary. CBRN Surveillance and Reconnaissance is a specialised field of gathering intelligence about CBRN weapons. Timely inputs can help warn possible victims and enable them to take requisite precautions for saving lives. It also helps commanders in planning 'Fighting Dirty' missions in contaminated environments. Comprehensive surveillance, early detection and reconnaissance of CBRN incidents will be crucial for the safety of soldiers and first responders in future warfare.

PRINCIPLES

Reconnaissance is a mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of an enemy, or about the meteorological, hydrographic, or geographic characteristics of a particular area. CBRN reconnaissance is a specific type of reconnaissance. The purpose of CBRN reconnaissance is the detection and identification of CBRN hazards. This includes finding gaps and detours around CBRN-contaminated areas. The operations can be further classified as under:

- CBRN Surveillance. CBRN surveillance is the systematic continuous observation of an area to provide early warning of likely contamination. Rapid assessment of changes in aerial content, soil deposits and surface contaminants is essential for real-time response.
- CBRN Reconnaissance. CBRN reconnaissance is a mission undertaken to obtain militarily significant information about the CBRN condition of routes, areas, and zones. This information confirms or denies the presence of CBRN attacks or hazards with detection and identification equipment. Visual observation or the collection of samples in the specified location or region can also provide this information.
- CBRN Survey. CBRN surveys are missions conducted to collect detailed information on CBRN contamination hazards. The survey determines the type of contamination, the degree (extent/intensity), and the boundaries.
- CBRN Sampling. Sampling operations provide physical evidence of CBRN attacks and technical intelligence concerning the enemy's CBRN weapons systems.

PURPOSE

The goal of CBRN reconnaissance is to produce actionable combat information to allow friendly forces to avoid contaminated areas. CBRN reconnaissance also can produce technical intelligence concerning the enemy's offensive CBRN capability. CBRN reconnaissance is part of the overall intelligence collection effort. It is performed in advance of other combat operations, as well as during them, to provide information used by the commander to confirm or modify his concept. CBRN reconnaissance is conducted throughout the framework of the battlefield from the forward combat area to deep in the theatre's rear area. In essence, it entails:

- To produce combat information to allow friendly forces to avoid contaminated areas.
- CBRN reconnaissance is part of the overall intelligence collection effort.
- It is performed in advance of, and during, other combat operations, to provide information to the commander to confirm or modify his concept of battle.
- CBRN reconnaissance is also conducted throughout the framework of the battlefield from the forward combat area to deep in the theatre's rear area.
- CBRN reconnaissance missions are conducted wherever the enemy has the capability of employing CBRN weapons.

FUNDAMENTALS

CBRN reconnaissance operations are planned and performed with six fundamentals in mind:

- Retain freedom of manoeuvre.
- Orient on the threat.
- Report all information rapidly and accurately.
- Develop the situation rapidly.
- Avoid contact with enemy forces.
- Maximize the capability of CBRN reconnaissance units.

Retain Freedom of Manoeuvre. By avoiding contaminated areas, the commander maintains freedom of manoeuvre. Knowing the location of contaminated areas allows all units to practice the first principle of CBRN defence - contamination avoidance. This limits the effects of degradation on soldiers operating at high MOPP levels.

Orient on the Threat. CBRN reconnaissance operations are limited to those areas where the enemy can employ CBRN weapons. The use of persistent chemical agents is the major threat that the majority of CBRN operations will be directed against. The intelligence preparation of the battlefield will identify where, when, how, and why the enemy will employ his CBRN weapons. It is impossible to conduct CBRN reconnaissance continuously at all points on the battlefield. This intelligence report assists in focusing the CBRN reconnaissance effort at the most critical places and times on the battlefield.

Report All Information Rapidly and Accurately. CBRN reconnaissance is performed to obtain information. Higher commanders need this information to confirm or make decisions. CBRN Surveillance along forward deployment and routes of the advance can aid in effective early warning to friendly troops and pre-emptive actions. Combat information loses value quickly. Negative reports tell as much as positive reports. Accurate and real-time reporting of locations is essential to avoiding CBRN hazards.

Develop the Situation Rapidly. Once contamination is encountered, the unit performing the mission must

Reconnaissance can be manned or unmanned. For unmanned reconnaissance, robotic means (both ground and aerial) can be used. Robotic Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs) are used when you cannot or do not want to send personnel in a contaminated environment

CBRN Centres integrated with the respective HQs should have matching CBRN SADSS. Data inputs from field-deployed sensors, either from the AICBRNS or the RVs should be received in real-time via secure data networks at the SADSS

rapidly identify the type and intensity. The extent of the contaminated area and possible bypass routes or gaps must be quickly identified.

Avoid Contact with Enemy Forces. Detecting and identifying CBRN agents is extremely difficult on the battlefield. Many of the detection procedures are time-consuming. Contact with enemy forces has a degrading effect on CBRN reconnaissance operations. It is seldom possible to accurately detect and identify CBRN agents while in close combat.

Maximise the Capability of CBRN Reconnaissance Units. When selecting a CBRN reconnaissance unit to perform a task, the commander must consider various capabilities and limitations of the unit. Optimal use of technologies and remote networked sensors can aid the judicious employment of reconnaissance units. The mobility, survivability, and detection capabilities of each type of unit are considered when assigning tasks and missions.

CBRN RECONNAISSANCE OPERATIONS

CBRN reconnaissance operations support the CBRN principle of contamination avoidance. CBRN reconnaissance provides commanders with freedom of manoeuvre and minimizes the degradation from operating under CBRN conditions. The CBRN Reconnaissance teams (dismounted) and the CBRN Reconnaissance Vehicle (RV) have to be suitably equipped to perform all the tasks given below:

- Detection. Detection for timely warning of units - Identify if an event has occurred - Discover location - Find the device/source - Transmit warnings.
- Identification. Confirms other detection inputs. Supports protection level selection, preventive measures, and casualty treatment.
- Marking. Marking allows friendly forces to avoid the hazard – Mark point of contamination – hot spots, boundaries and safe zones/routes.
- Reporting. Allows resource status assessment and mission asset assignment - Hazard mapping - Confirmation by wide area survey.
- Sampling. Sampling aids the identification - Detect and identify the type of contamination. Also aids forensic confirmation to pinpoint the source.
- Casualty Management. Immediate First Aid.
- Immediate Decontamination. On-site immediate decontamination for critical onboard equipment.

CURRENT CONCEPT

The Army presently uses a combination of manual and sensor-aided CBRN reconnaissance procedures. Surveillance for possible CBRN strikes or incidents is not in vogue.

Nuclear. For Nuclear, there is the NBC Sentry, a trained soldier who, on inputs of a likely nuclear strike, stands and scans the skies with his instruments. On sighting a strike, he must record the time of burst, the height of the burst and flash-to-bang timing. All this in the few seconds that the immediate effects will last. (Notwithstanding the teaching that one must drop flat on the ground and face towards the direction of the blast.) These readings are then transmitted to the CBRN Centre via secure communication channels as the NBC 1 report to calculate the possible yield and work out the hazard template. Sensors with armoured vehicles and RVs also give more accurate readings of radiation and can reconnoitre the area after the blast effects to ascertain the radiation type, spread and hotspot(s), and feed the data for hazard mapping and prediction.

Chemical. Signs of early symptoms and/or signs of a chemical release would evoke a rapid response. The response will be in terms of MOPP levels and specialist teams reconnoitring the area with hand-held or RV-borne sensors to ascertain the spread and hotspot(s), and feed the data for hazard mapping and prediction.

Biological. Presently there are no field Bio reconnaissance procedures unless there is an indication of a disease spread. Samples can then be collected and sent for analysis. Bio agents (albeit quite lethal) have a manifestation period and do give some reaction time.

NEW CONCEPT

The new concept of CBRN surveillance and reconnaissance aims to use modern technology to obviate risk to humans and enhance real-time detection and response capability. Surveillance along manned (and unmanned stretches) defences and borders can be achieved by advanced integrated sensors deployed at select sites to give complete coverage and detection of possible releases or strikes. In addition, holding forces and Border Security agencies can be equipped with drones suitably integrated with CBR sensors for early detection of any suspected hostile releases and initiate protective protocols.

Reconnaissance can be Manned or Unmanned. For unmanned reconnaissance, robotic means (both ground and aerial) can be used. Robotic Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs) are used when you cannot or do not want to send personnel in a contaminated environment. Such robots are small, self-deployable and autonomous in function and can be fully managed and monitored from the parent post or RV. Technology has enabled miniaturised UGVs and UAVs, which can carry payloads of CBR detectors for CBRN reconnaissance. The use of such vehicles will reduce the exposure of humans to contamination and increase the effectiveness and scope of the reconnaissance.

The Integrated Concept. The concept entails the carriage of two mini UGVs and one small UAV (quadcopter) fitted with CBR sensors/detectors and live secure video feed capability. The UGVs are integrated with the onboard Situation Awareness and Decision Support System (SADSS) on the CBRN RV and can transmit non-line-of-sight data feed of video and readings of the CBR detectors up to one-kilometre distance.

The CBRN RV moves on the battlefield along with the tactical force. Either on call or upon sensing contamination by onboard systems, the CBRN RV unleashes the UGVs and UAVs to get detailed info on contamination in the area surrounding the CBRN RV. These surrogates go into the contaminated zone and pass back information through secure non-line-of-sight data feed to the SADSS on the CBRN RV.

The mother vehicle crew can manoeuvre the surrogates to identify hotspots and into inaccessible areas. This allows reconnaissance of difficult contaminated areas where it may not be possible or advisable to send personnel. It also affords wider and better coverage of the contaminated areas in a shorter period.

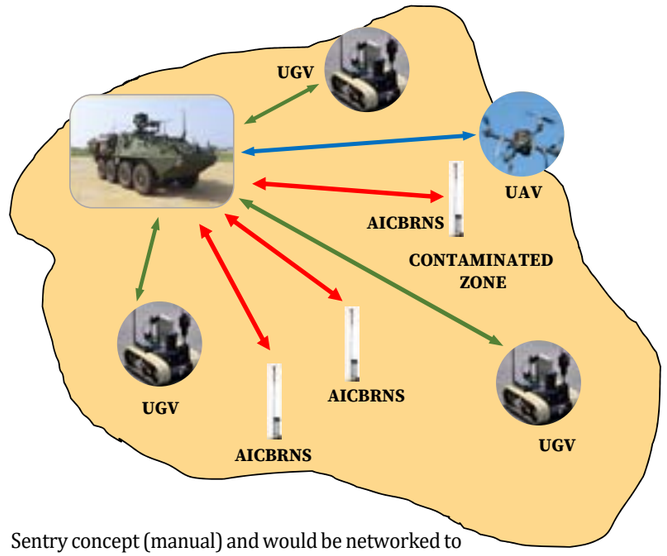
Based on the inputs of the surrogates, the CBRN RV moves in for sample collection and detailed analysis. All surrogates and onboard detection systems are integrated into the SADSS for near real-time response. Similar actions are undertaken by the other CBRN RVs in the unit and a complete area reconnaissance is conducted.

INTEGRATED CBRN RECONNAISSANCE CONCEPT

Based on the inputs and analysis provided by the CBRN RV and its surrogates, the Unit commander can take necessary tactical decisions for the continuation of operations. The CBRN reconnaissance unit can also identify suitable clean and secure areas for casualty management stations and for decontamination stations.

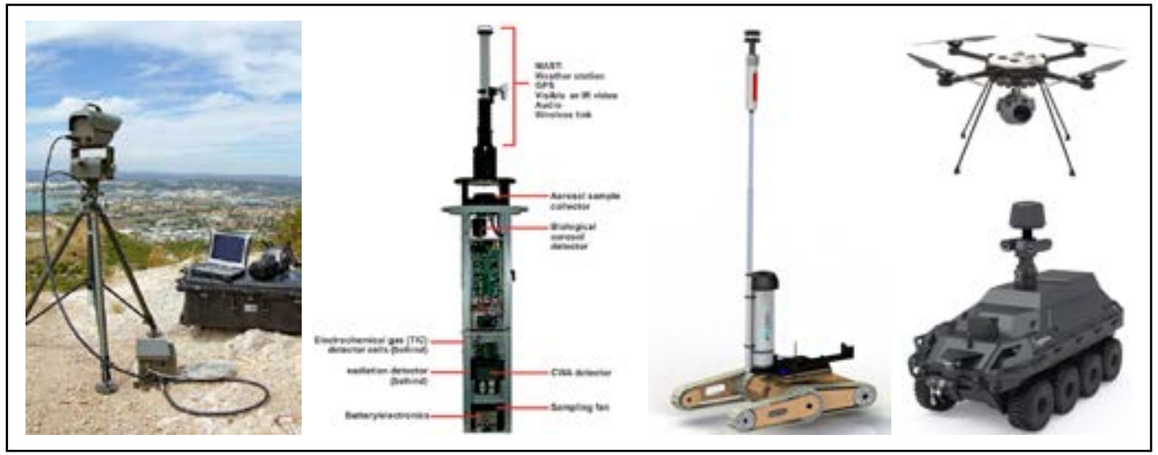
EQUIPMENT SPECIFICS AND FIELD DEPLOYMENT

Automated Integrated CBRN Sentries (AICBRNS). The AICBRNS constitutes detection systems for Chemical, Biological, Radiological and Nuclear detection. The AICBRNS replaces the erstwhile NBC



Sentry concept (manual) and would be networked to the SADSS of CBRN Centres at Battalion HQ, Brigade and above. The AICBRNS integrates into a single unit:

- **CBR Sensors/Detectors.** Compact, lightweight and modular sensors, to detect and record agent parameters, (Agent identification, intensity, persistency, volatility, and hotspot locations). An operating range of 100m in battlefield conditions would be optimal. The detection would be point/proximity detection on occurrence/release.
- **Nuclear Blast Detector.** The AICBRNS device also has a 3600 infra-red camera (both in azimuth and elevation) suitably ruggedised, stabilised, filtered and integrated with sensors to detect nuclear explosion parameters (height of burst, flash to bang time, distance from observer and direction) and automatically work out the likely yield. Similar to the Bhang meter but much smaller, more accurate and more effective.
- **Met Sensor.** The AICBRNS also has a met sensor to compute the met data for transmission to the CBRN Centre.
- **Form Factor and Mounting.** Such integrated devices should be compact and lightweight, and can be mounted on a tripod mount, fixed on a vehicle (reconnaissance vehicle or Command vehicles), UGVs or even mounted on static structures/buildings. These devices can be integrated into the holding formation reconnaissance and support teams or with the forward line of defences. They can also be used on vehicles mounted with strike formations reconnaissance units and all engineer task forces. The AICBRNS should be compact enough to be a payload on UAVs and UGVs for



There are some advances made by some European companies to develop integrated sensors. However, none include a nuclear blast parameter detector yet. Systems like Bhangmeters do exist for satellite recordings. It may be a good project for Indian companies to develop a truly viable AICBRNS under 'Make in India'

remote use on the battlefield (open terrain and in Built Up Areas [BUA]).

- **Networking.** All AICBRNS shall be networked via dedicated wireless secure data channels to the CBRN Sit Awareness and Decision Support System (SADSS) at the CBRN Centres and RVs.

In a defensive layout as obtaining in hostile/sensitive borders, line of control and forward defences in occupied territories, a grid system of deployed sensors is required. These sensors or Automated Integrated CBRN Sentries (AICBRNS) should be deployed ahead of field defences, on bunkers and watch towers and on mobile reconnaissance platforms. The aim is to establish a comprehensive sensor network linking UAVs (or drones), and UGVs with the CBRN RV and CBRN Centres. The system will be interoperable with older surveillance technology to provide a recognised CBRN picture that should enable a common operational picture shared across all levels of command.

The AICBRNS should have a detection range of 100 metres radius, with some systems based at critical locations having a long-range detection capability (up to 5 km). It should be ensured that the detectors are advanced enough to be able to detect CBRN contamination over other battlefield interferents. They would also be networked with CBRN RV (tracked or wheeled). The AICBRNS would be in addition to the hand-held systems carried by dismounted reconnaissance teams.

CBRN Reconnaissance Vehicle (RV). The CBRN RV, which provides for a protected environment, should have matching mobility with other mechanised forces. It should have limited floatation capability to undertake reconnaissance across water bodies (canals, lakes, rivers). The CBRN RV should have the following equipment integrated on board:

- Detection and Identification Equipment for CBRN detection. The RV can have a vehicle-based version of the AICBRNS in addition to other sensors to build redundancy. Duplication of detection equipment (space permitting) can help rule out false alarms and help in confirmation of contamination. Hand-held detectors should also be provided for manned dismounted reconnaissance. Suitable analysis equipment must be integrated onboard.
- Sampling Equipment. This should cater for both surface/soil sampling for liquids and powders and air sampling for aerosols, gasses, and vapours. Sampling should be remotely controlled to avoid exposure of the crew to outside contamination.
- Situational Assessment and Decision Support System (SADSS). The CBRN SADSS should include Hazard mapping and prediction, automated report generation and warning, and mission planning for fighting dirty. Data inputs from field-deployed sensors like the AICBRNS, UAVs and UGVs should be received in real-time via secure data networks at the SADSS on the RV.
- Met/weather station. Integrated to aid hazard prediction.
- Personal protection equipment for the crew for dismounted tasks.
- Marking equipment in the form of spikes, pickets, or buoys.
- Immediate Decontamination equipment like advanced quick-apply powders, foams or gels (PDAs and PDKs).
- First Aid kits and casualty bags for immediate casualty management.
- Secure a dedicated CBRN communication network.

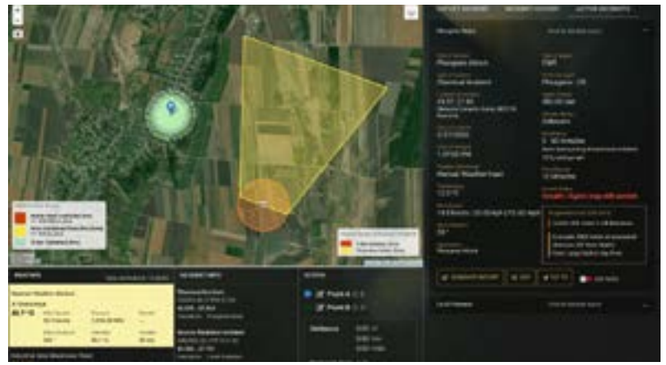
CBRN Centre. CBRN Centres integrated with the respective HQs should have matching CBRN SADSS. Data inputs from field-deployed sensors, either from the AICBRNS or the RVs should be received in real-time via secure data networks at the SADSS. The SADSS at the HQs should include an additional administrative package catering to logistic issues such as stocking status, shelf-life calculators, inventory management, demand and disposal data and sizing rolls. The SADSS would be integrated into a co-opted Met sensor or weather sensor.

INDIAN INDUSTRY

AICBRNS. There are some advances made by some European companies to develop integrated sensors. However, none include a nuclear blast parameter detector yet. Systems like Bhangmeters do exist for satellite recordings. It may be a good project for Indian companies to develop a truly viable AICBRNS under 'Make in India'. There could be two versions, a basic one without the Nuclear blast detector unit and another advanced version with it.

CBRN RV, UGVs and UAVs. CBRN RVs exist in many countries and work is on to improve their capabilities. Many companies have also developed CBRN UAVs and UGVs. However, system integration of these as surrogates to the RV has not yet been achieved. The Indian CBRN RV based on the BMP 2 is passe. We need to look for a better integrated ICV platform for the CBRN RV while integrating the AICBRNS and the UGV and UAV surrogates, all controlled by a rugged CBRN SADSS. A lot of Indian companies are already producing reliable UAVs of various types. Some can be used for integrating the AICBRNS when developed. Some companies are also developing UGVs in India. An effort is needed from the Government (MoD and MHA) to assist in such development.

CBRN SADSS. Some Indian companies are already working on a SADSS. There is a need to standardise the system and keep it compatible with future digital platforms for seamless integration.



CONCLUSION

CBRN surveillance and reconnaissance entails five critical tasks on the battlefield — detect, identify, mark, report, and sample. Early detection of CBRN hazards is required for timely warning of units and personnel in affected areas. Detection of contamination is the cornerstone of contamination avoidance. Rapid identification is needed to adequately protect soldiers against CBRN hazards. The use of robotic vehicles and detectors will be force multipliers in CBRN reconnaissance. Optimal use of such technologies will enhance operational effectiveness and aid in saving lives. ■

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