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CBRN SECURITY FOR A METROPOLITAN REGION

BY COL RAM ATHAVALE, PhD

Introduction

Over the years, towns have grown larger into cities and metropolitan areas. They comprise residential areas, industries, corporate offices, large and small businesses and associated governance and administrative systems. The combination of these creates many toxic scenarios and polluted environments. Especially industries using a variety of chemicals, sewage treatment and waste disposal plants spew out toxicity in the urban environs. While much control and precautionary measures are invested in, we have seen major accidents in urban settings.

The horrors of Bhopal, India (1984) or Lac Mégantic, Quebec (2013), the countless boiler accidents, firecracker industry fires and the tons of toxic wastes that abound in our cities are enough to raise public paranoia. In addition to these horrors, port explosions and toxic fires like the Beirut Blast of 2020 and Tianjin Port explosions, China are a reminder of how toxic releases can devastate a city or part of it. A major CBRN accident or incident occurring in a city jurisdiction can wreak havoc and result in a multitude of casualties. Hundreds of helpless convulsing victims gasping for air surrounded by toxic gasses or vapours can seriously and rapidly overwhelm any response and healthcare mechanism. See the effects of COVID 19. The whole world got a terrible scare and even today many countries are battling the scourge of the pandemic. Wave after wave is having a devastating effect not just on the lives of people but on livelihood, business, and administrative capabilities.

Then there is the threat of a CBRN terrorist event. Deliberate sabotage of a research laboratory, or a toxic chemical plant or warehouse, causing a release in a crowded public place or high visibility event (a World Cup match or festivals like Eid, Christmas or Diwali) brings to mind horrors seen in Douma, Syria or Halabja, Iraq. The ongoing Ukraine war has raised the spectre of nuclear weapons being used on cities and towns, aka Hiroshima and Nagasaki. There

is even talk of Chemical, Biological and Radiological (CBR) threats and false flag attacks. It makes you ask the question, are our cities prepared for a mass toxic CBR incident? Or for that matter a Nuclear one?

While a nuclear war may seem presently unlikely, the threat exists like a sword of Damocles. The chemical and biological threats are very real as seen from the various incidents increasing with uncanny rapidity. There is no doubt that we need to be prepared to prevent, and if required protect our cities from such Chemical, Biological, Radiological and Nuclear (CBRN) threats. It needs deliberate and comprehensive actions by many stakeholders to effectively secure our cities. I have endeavoured to discuss the various steps and measures that should be taken for just such an eventuality.

Measures to Secure the Metropolitan Region

Contours of a Metropolitan Region.

The country can be divided into high density clusters of metropolitan regions. A metropolitan region is essentially an enlarged city with suburbs and outlying areas such as industrial parks, airports or ports, and even some smaller settlements absorbed by growing civilisation. It consists of large business districts, public transport hubs, critical infrastructures like seats of power, government buildings, historical monuments, tourist places of interest, sporting stadia and the vast residential complexes. Add to these the essential services that actually keep the region running namely water, electricity sewage, waste management and sanitary services. Then there are the logistics that help replenish and feed the households and businesses. This huge complex system has many risks and vulnerabilities. Before we look towards securing the region, we need to comprehensively analyse the risks and vulnerabilities. It will help us understand what are we securing the region against.

Risk Analysis and Vulnerability Assessment (RAVA).

The first step is to understand the types and magnitude of threats and risks. Each of the sub threats like chemical, biological or radiation need to be realistically analysed and assessed. Terrorist capabilities are ever-rising, and rapid and rampant industrialisation pose a myriad array of CBRN threats. These threats coupled with ill-planned urban infrastructural growth and overcrowding of cities lends to many risks and vulnerabilities.

CONSIDER THE SEVERTY OF INJURYILLNESS	CONSIDER THE LIKELIHOOD OF A HAZARDOUS EVENT OCCURRING				
RISK ASSESSMENT MATRIX	**Very Unlikely to happen**	**Unlikely to happen**	**Possibly could happen**	**Likely to happen**	**Very Likely to happen**
Catastrophic (e.g.fatal)			High	Critical	Critical
Major (e.g.Permanent Disability	Low	Moderate		High	Critical
Moderate (e.g. Hospitalisation/ Short or Long Term Disability)					High
Minor (e.g.First Aid)	Very Low	Low			
Superficial (e.g. No. Treatment Required)	Very Low	Very Low	Low	Low	

Risk matrix based on Impact and Likelihood: Credits SiteSafe, Australia

Risk Zoning

Every city has an adjoining industrial area. Especially industries like pharma, plastics, paints, pesticides, and fertilizers. There would be many sewage plants and waste disposal areas. Some cities may have research labs handling toxic substances. There could even be a nuclear power plant in the vicinity. Ports and warehousing sectors (including container parks and large cargo transhipment facilities) may be storing tons of toxic chemicals or hazardous substances (remember Beirut, Lebanon or Tianjin, China). Risk Zoning is the technique of mapping risk areas, as given above, on a digitised map of the metropolitan region. GIS techniques (using vector and raster maps) are used to plot specific risk clusters on the map; they can be grouped based on localities, types, and levels of risks in clusters or zones. These zones should be numbered for easy reference. Additionally, risks should be graded based on type (chemical, biological, radiological, or explosive), impact (health, environment, business), severity, likelihood and kind of response. Such grading should take into consideration the Sendai Framework classification of manmade hazards.

(https://council.science/sendai-hazard-review).

Vulnerability Zoning

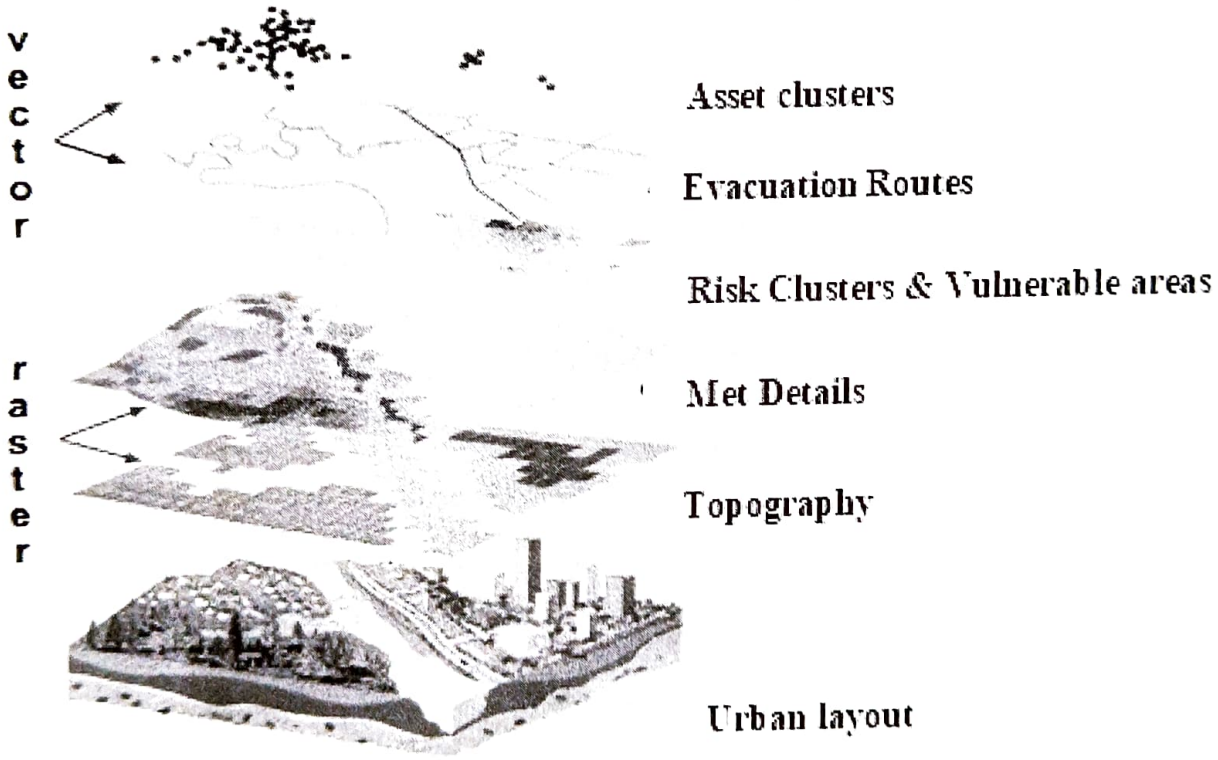
Critical infrastructures like water treatment plants, important government buildings, courts, airports, railway stations, metro stations, important public places, tourist spots and crowded/popular markets all are vulnerable areas in a city. These need to be included as a data layer in the vector mapping. Water bodies, their flow speed and direction should be mapped too. Toxicity in water bodies can lead to large areas of the city being vulnerable to contamination. Vulnerability will be dictated by the importance of the site, population density/ footfall and impact of a hazard manifesting there. These should be mapped as a digital overlay/layer to the risk zoning map.

Asset Assessment and Mapping

To protect and respond to any CBRN threat, there is a need for careful creation and assessment of assets. These could be infrastructural or in terms of human resource. The Government has established the National Disaster Management Authority. Under this agency there is a need for creating a nation-wide database (routinely updated) for managing the inventory of equipment, skilled human resources and critical supplies for emergency response. Primary focus is to enable the decision makers to find answers on availability of equipment and human resources required to combat any emergency situation. Such a database will also enable them to assess the level of preparedness for specific disasters. The database needs to be updated for CBRN related assets too. A realistic assessment of existing assets needs to be carried out. These should be also plotted as a layer to the risk and vulnerability vector plots. Different stakeholder assets like police, fire brigades, civil defence and available special response teams or paramilitary forces must be included. These should be clubbed in 'response clusters' on the plot. A study of the plots of risks and vulnerabilities as compared to the asset cluster plot will throw up anomalies in asset deployments (if any), in terms of rapid response capability to the risk and vulnerable zones. Further, the type of assets (human resource, transportation and equipment) and their imbalance in different asset clusters will also get highlighted.

Meteorological Assessment

The complete area under consideration should be analysed and mapped (raster mapping) for meteorological conditions. Wind speed and direction, ambient temperatures, ambient pressure, altitude, precipitation, and relative humidity assessments are important while analysing the likely spread of toxic contamination. Today we can have continuously updated met data with minute-to-minute specifics for ease of planning. Such parameters have effects on contamination spread and dispersion levels. Similarly, met conditions at varying times over a 24-hour cycle should also be mapped to analyse the temperature variations and inversion mechanics. This data can be sourced from the local met office, or the airport met department. Additionally, all critical infrastructure and high-risk facilities must have their own met sensors digitally networked to the hazard mapping system.



Representative image of GIS based mapping and zoning

Comprehensive CBRN Security Architecture

To enable and empower a metropolitan region to prevent and if required deal effectively with a CBRN incident the following needs to be instituted and executed.

- **Preventive measures**
- **Preparatory/precautionary actions**
- **Integrated Hazard Mapping and CBRN Control System**

Preventive Measures

After understanding and analysing risks and vulnerabilities, certain precautionary actions would go a long way in preventing and/or mitigating toxic risks from developing into disasters.

- **Distancing of Risk Areas.** Town planners must keep in mind the risk areas (like factories, warehousing, waste management and sewage disposal) and locate these well away from residential areas and other vulnerable areas as discussed above. In addition, while deciding the location of such high-risk facilities, meteorological inputs must be considered so that any possible release or exposure of toxicity flows away from the town and not into it. It should also be ensured that a clear perimeter of at least half a kilometre around such high-risk areas is kept free of residential complexes, slums, and labour colonies. Where existing high-risk areas have got surrounded by residential localities, the industry and the Government should consider shifting these to a safer location or creating a buffer zone and adding enhanced safety measures to avoid any hazard.
- **Legislative Mechanisms -** Laws and Acts for CBRN. CBRN incidents can cover a wide spectrum from natural to manmade (industrial, logistics, medical) to terrorist incidents. The State needs to develop and refine existing laws and acts to ensure due prevention of CBRN incidents. Further, laws to cover all stages of toxic substances from creation/import to disposal need to be framed and executed. Laws must give out the prosecution aspect to ensure compliance. Some laws need regulations and SOPs to be developed by next rung of administration. All such laws, acts and regulations need to be backed by implementing, executionary and oversight mechanisms.

- **Strict Oversight and Audit.** All high-risk facilities are required to follow a strict safety protocol. Such oversight mechanisms are mandatory in all facilities. While the in-house Health, Safety and Environment (HSE) managers and their team would be responsible for ensuring the safety of workers, staff and equipment, the Government has instituted laws and regulations for occupational safety and mandated third part safety and security audits. These if done diligently and as per the required schedule can minimise the risks and help maintain good safety standards. Global industrial or workplace (industries, trade and commerce, logistics and waste management) safety best practices like regular third-party audits, oversight mechanisms and, Globally Harmonised Labelling System (GHS) need to be assiduously adopted.
- **Surveillance and Early Warning (EW).** As part of the safety protocol at all high-risk facilities and at important vulnerable areas, suitable early-warning sensors need to be deployed. The sensors, fixed or mobile (vehicle, drone or robot based) would carry out 24/7 surveillance over the risk areas. Such sensors would detect toxic release or spread in real-time mode and trigger alarms. These alarms would be networked for necessary actions (simultaneously by multiple stakeholders) as explained in subsequent paragraphs. In addition to the alarms at high-risk facilities and critical infrastructures, the Metropolitan authorities need to institute a set of standard automated alarms or warnings over multiple media to pre-warn the citizen about an emerging threat.

Preparatory/precautionary actions

Post a detailed RAVA and instituting necessary preventive measures, there is a need to plan and prepare for a possible CBRN threat. The main aim of such actions is to limit casualties, prevent escalation of the threat and minimise its effects. Some key preparatory and precautionary activities are discussed below.

- **Asset creation.** There is a need to create the right assets to be able to protect people and respond effectively to the emerging threat. The assets can be infrastructural, research and suitably equipped human resource.

    - **Infrastructural Assets.** There is a need to create and improve certain key infrastructural assets. In most parts of western Europe, the metro train stations and tubes are well underground, enabling them to be used

as temporary sheltering means in a CBRN attack. Similar sheltering measures need to be instituted in cities, under critical infrastructures and industrial parks. Other than such large underground shelters, strong overground facilities and buildings that can be used as temporary sheltering need to be studied and upgraded with sealing and clean air systems. In addition to these, residential societies and public facilities (malls, administrative and corporate infrastructures) which have secure underground parking can well be converted to provide such secure sheltering. All critical infrastructures need to create temporary stay-safe chambers or rooms with independent Heating, Ventilation and Air Conditioning (HVAC) systems (including CBRN filtration). Secure in-house power sources for any widespread power disruptions (could be due to power grid failures or EMP strikes by adversaries) need to be installed. Suitable evacuation routes and assets will need to be planned for shifting people to safer places once the situation permits. The Ukraine crisis has brought out many lessons in temporary sheltering of the citizens in heavy attack scenarios. For CBRN protection, sheltering facilities will need sensors, alarm systems, sealing mechanisms and CBRN filtration systems for clean and secure environments.

- **Sensors and Detectors.** There is a need to deploy static and mobile sensors and detectors for surveillance of critical infrastructures and high-risk areas for possible threats. These will help prevent a CBRN incident. All high-risk facilities must have such systems. There are many fixed and mobile detection and early warning systems available in the international market. Most of these are used in a networked manner with automated hazard prediction and early warning systems. More about this below.
- **Research and Forensics.** State of the art research and forensic capabilities are a must for effective prevention and response to a CBRN incident. High containment and secure laboratories to analyse and develop antidotes, drugs and vaccines are needed. While some laboratories do exist, there is a need to increase footprint and enable all major cities with such analytical facilities. Similarly, forensic laboratories to rapidly identify and analyse contamination in an interventional or response situation can be a huge asset in escalation prevention and minimising casualties. For an effective response, there is a need to also create, at the Metropolitan level, mobile laboratory assets (field laboratories) for rapid deployment at the incident site. Such CBRN mobile laboratories are being developed by some vendors.

- **Human Resource.** The key component in any preventive intervention or response to an emerging CBRN incident is the human resource. Response teams of suitably trained and equipped personnel are essential. Many stakeholders would be part of any intervention or response scenario. The Armed Forces do maintain well trained and equipped CBRN Quick Reaction Teams for battlefield requirements, however there is a need to build on-site response teams at all high-risk facilities to avoid response time lags and increase response footprint. These could be part of the on-site security and staff manning such facilities. In addition, the security staff at all critical infrastructures and important public places, local police, fire brigades and Civil Defence personnel, all need to be adequately trained and equipped for immediate mitigation and escalation prevention. Basic awareness and mitigation training should also be imparted to private security staff in residential areas with local volunteers (preferably from within the Resident Welfare Associations [RWA], residential societies or resident committees) supplementing such assets. The importance of Civil Defence and local volunteers in saving lives has been demonstrated in the Ukraine crisis and in many instances in India too.
- **Training and Equipping.** Without optimal training and adequate equipment, no response can be successful. Especially in CBRN scenarios, standardised basic training needs to be instituted. Training is required for all stakeholders. CBRN training can be graded from basic to advanced as also based on the need for different levels of application from administrators and decision makers to first responders. Hence, there needs to be a central institute or centre that imparts the training. CBRN equipment is expensive, especially sensors and detectors. Therefore, correct operation, fitment and due maintenance must be inculcated in the personnel who are to use these. Training aids like simulators and virtual reality or augmented reality (VR/AR) systems should be used. There are companies that make such training aids for safety and enabling the users. The VR/AR aids can be customised for specific requirements like use of detection equipment, wearing of protective gear, decontamination techniques and also for medical management in field.
- **Critical Equipment Production and Emergency Stocks.** COVID 19 hit us all in early 2020. Simple things like masks and sanitizers were considered fashion accessories of rich people. As COVID 19 struck,

suddenly there was a scramble for these items. Of course, there was a dearth of PPE, ventilators and even hospital beds. Critical medicines stocks were low and there was general panic. Fly by night businesses began cashing in on locally made PPE, masks and sanitizers. Some entrepreneurs also resorted to flash imports. Quality was grossly ignored till the concerned authorities published norms and standards. In a mass CBRN situation, there will be a short-term yet sudden need for such critical items in great numbers. There is a current system for emergency stocks for natural disasters. This system should be enhanced with CBRN related stocks in these stores. Planned CBRN equipment stocks at select strategic locations within easy access to various cities and the capability to ramp up production in a crisis are needed. Holding stocks is a costly affair. Due care should be taken to review stocks based on market availability and the residual life of these lifesaving items.

- **Essential Drugs and Antidote Stocks.** As in the case of critical equipment, essential drugs and antidotes need to be stocked for critical CBRN situations. The need for such stocks shall be immediate and due consideration and planning must be undertaken for their rapid deployment in the affected areas. A periodic review with pharmaceutical companies must be undertaken to ensure optimal availability and production dynamics in case of emergent large-scale requirements. Public-private research partnerships to revise vaccine and antidote policies and aid in the development of newer and better vaccines based on anticipated demand for emerging threats must be catered for.
- **Sensitizing Stakeholders and Populace on CBRN Threats and Their Mitigation.** The most important preparatory or precautionary action is to create and enhance awareness about CBRN threats and mitigation measures. Today, despite COVID 19 raging in the environment for two years, the level of awareness and understanding is low. We need to organise awareness workshops for all possible stakeholders. Government agencies like home, police, hospitals and healthcare, municipal services (water, fire, emergency services, sewage, waste management, crematoria), paramilitary forces all need to be adequately sensitised and trained. Sensitizing citizen including students and workers is essential. Sensitisation using well-structured campaigns on social media, print/digital media and/or FM radio jingles can be considered. We also need to train School & College students

in understanding the basics of CBRN risk mitigation. Due emphasis is needed for training and sensitizing the staff and workers of industries and logistics agencies (transportation, warehousing and bulk handling). Again, the need for a central CBRN Institute to standardise, coordinate and structure such workshops and training is felt.

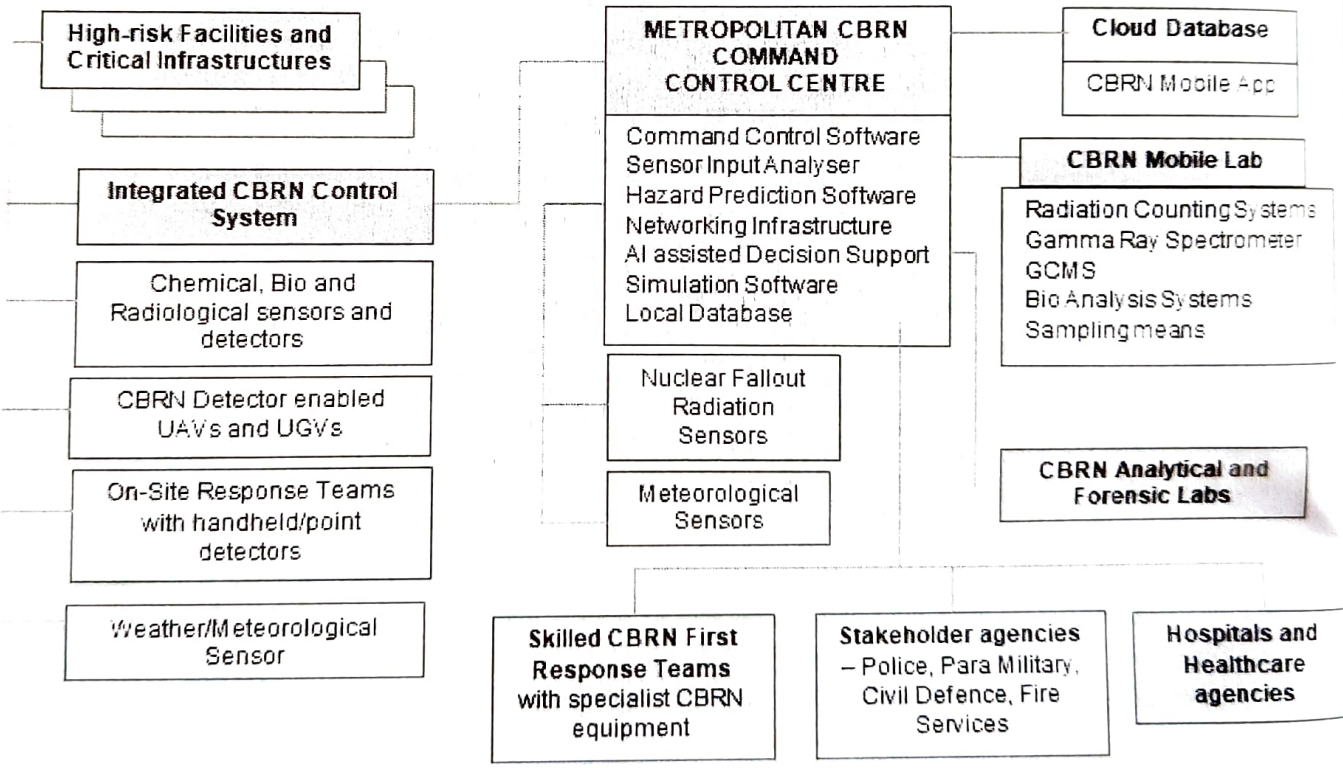
Integrated Hazard Mapping and CBRN Control System.

Keeping in mind the requirement of managing the multifarious CBRN detection and sensor deployments at high-risk facilities and critical infrastructures, there is a need to integrate these into a single command and control system at each metropolitan regional headquarters. The Government has already put in place a security based networked system. We need to expand such initiatives to include an Integrated CBRN Control system.

- **The System Architecture.** The Integrated CBRN Control system is a digitised platform wherein all CBRN sensors and detectors (early warning) are networked to a control station. Each high-risk facility and critical infrastructure should have such a control station. This should should be integrated with the Integrated Metropolitan Command and Control Centre. The System has the following parts:
  - Sensor data receiver and analyser
  - Meteorological
  - Hazard Prediction with automated warning system
  - Decision support system
  - Resource inventory control

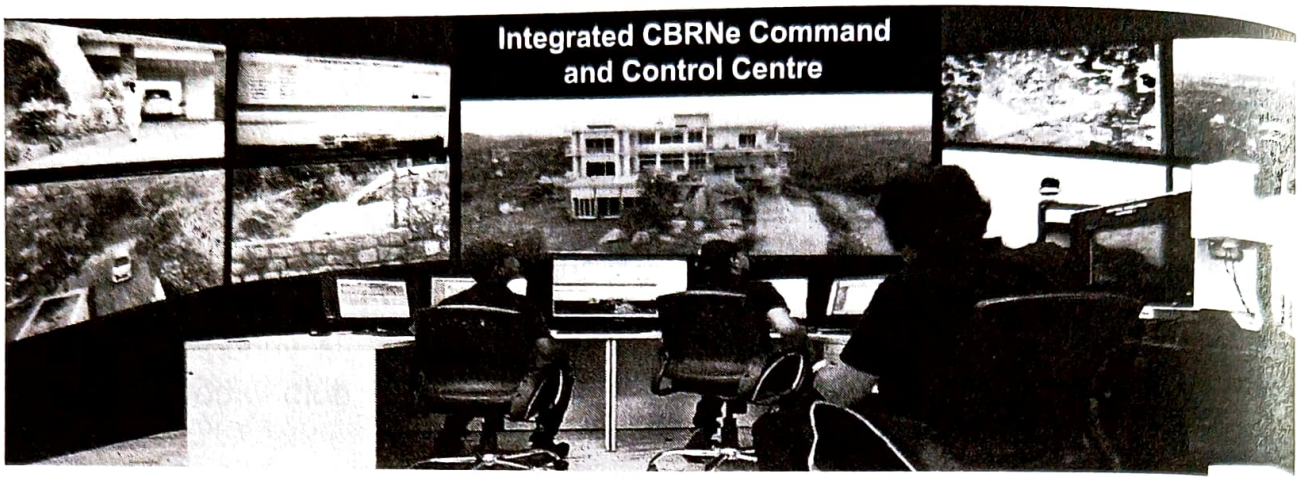
- Every high-risk or critical infrastructure should have a set of deployed sensors (both fixed and mobile depending on the layout and sensitivity of the venue). These should be networked into a local Command and Control station that can process the incoming data from the sensors. The high-risk facility or critical infrastructure control station receives real-time inputs of any releases, spills, or contamination spreads in their areas. The inputs (including meteorological) are plotted on digitised maps and a hazard prediction map is generated. The system also makes identification and intensity assessments based on the inputs and assisted by Artificial Intelligence (AI). Based on the areas affected or likely to be affected,

automated warnings are relayed to the nearest response asset as per the mapping discussed above. Hazard mapping, situational reports and warnings are also relayed to the Integrated Metropolitan Command and Control Centre for alerting neighbouring localities and response assets. Associated stakeholders like the fire department, hospitals, police, forensics and others also get these warnings. Artificial Intelligence (AI) enabled Decision Support module of the Integrated Metropolitan CBRN Command and Control Centre gives suggested protection and mitigation measures to response teams and assists in directing forensics for early analysis. It also gives predicted figures needing hospital care and helps in the immediate planning of equipment and antidote/drug requirements. Alerts are sent out to hospitals in the vicinity and to the metropolitan health department.



Representative System Diagram of the Integrated CBRN Command and Control architecture

- **Sensor deployment.** There is a need to deploy a select range of CBRN detectors and sensors. These need to be identified based on location, type of threat envisaged, usage (fixed, roving or handheld) and optimal coverage. Stand-alone detectors can be deployed at key locations within and on the periphery of the facilities. A coverage modelling based on spread dynamics of likely threat releases can be developed for each location to optimally deploy such detectors. In addition, autonomous or partially controlled roving sensors and detectors can be planned for larger venues covering open grounds and clustered risk facilities. Such autonomous roving systems can be unmanned aerial vehicles (UAVs or drones) or unmanned ground vehicles (UGVs or robotic systems) with an onboard array of CBRN detection devices. Highly critical infrastructures may even have roof or mast mounted Stand-Off detectors capable of detecting approaching chemical threats from up to five kilometres. For pinpoint identification of the release/hotspots, handheld systems can be used by the response teams or Unmanned Ground Vehicles (UGVs) can be deployed for random coverage surveillance and for hotspot verification.
- **Alarm Mechanism.** The Integrated CBRN Control System will have an alarm mechanism included. The alarms would be audio-visual indicators with coding to indicate the type of hazard. The alarms can be transmitted not just to the facility-based control centre but also the main centre at the Metropolitan control room.
- **Alert and warning messages.** The Integrated CBRN Control Centre can generate automated user-specific alerts and warning messages. These would be updated as the situation unfolds and transmitted automatically to the concerned recipients.
    - **Stakeholders.** Various stakeholders who would need to be alerted would receive regular situational updates and alerts. These messages would be specific and contain hazard details, contamination spread predictions, actions at hand, mitigation measures and suggested further actions. Stakeholders can use these inputs to initiate precautionary and protective actions for as yet unaffected areas.
    - **Public.** Cautionary messages can also be generated by the Integrated CBRN Control System for the common public. These can be suitably integrated to be transmitted via social media, television and radio broadcasts. AI-generated Do's and Don'ts for mitigating the effects of the hazard can also be included for the specific type of hazard in these cautionary messages.



Representative image of an Integrated CBRNe Command and Control Centre. With permission of M/s Nucleonix Systems, Hyderabad, India.

- **Enhancing protection.** Certain aspects of mass protective measures have been discussed under asset creation above. In addition, some measures that could be undertaken to enhance protection levels are discussed below.
  - **Escalation Prevention and Containment.** Rapid escalation prevention and containment of the toxic release is of utmost importance. All high-risk facilities and critical infrastructures management must cater for mechanisms and drills for the same. Necessary immediate assistance equipment and stores should be stocked at all high-risk facilities and critical infrastructures. Staff and workers must be trained for all possible contingencies and prepare for the same.
  - **Collective Protection.** Every high-risk facility and critical infrastructure must cater for onsite protection for the staff and workers. Key installations may plan underground bunkers/holding rooms for the security of VIP and critical assets. For general public, underground assets like parking spaces, metro stations and tunnels or basement areas in Malls, hospitals and any other public infrastructure can be suitably modified for use. Due attention to the sheltering capacity, duration of stay and connected logistics must be given. Protected evacuation means and alternate routes need to be planned for various contingencies. First-aid measures should be catered for. Members of the staff who have a proclivity for nursing or first aid should be suitably trained. Similar selection and training are needed at residential societies. Volunteer members from resident committees can be trained. Where localities exist with no resident committees, local district offices must be tasked to do the needful. Signposting of essential helplines and nearest shelter

details. Plans should be developed at Metropolitan levels to convert a few metro/subway coaches or air-conditioned busses suitable augmented with CBRN sealing and filtration means.

- **Individual Protection.** As mentioned earlier, all stakeholder teams who may form part of response or intervention in CBRN incidents need to be suitably kitted out for optimal protection. CBRN suits, masks and Self-Contained Breathing Apparatus (SCBA) sets need to be provided. New technologies to lessen the physiological burden on the wearer and giving enhanced protection must be incorporated. There is a need to also stock a minimum number of kits (PPE and respirators) at all high-risk facilities and critical infrastructures, based on anticipated usage. The administration should widely distribute a booklet/handbook on CBRN Emergencies, which should include dos and don'ts for the common public. Simple protective and mitigative actions must be included in such booklets/handbooks. For wider distribution, schools and colleges and public places like malls and cinema halls can be used. Basic contents can be displayed at public places, malls and residential complexes.
- **Decontamination.** It is very essential to decontaminate even suspected items, body parts and equipment to avoid secondary contamination and save lives. In any CBRN incident which entails mass contamination, the Administration would set up centres for decontamination. Large vehicle wash centres can be quickly converted to effective decontamination stations.
- **Mass Decontamination.** A CBRN incident would affect a large number of people. In such instances, mass decontamination of the affected or even suspected of contamination would be required. There are procedures and drills to set up such mass decontamination centres at selected locations. These would need a huge supply of water and an open area which can accommodate the number of people to be decontaminated. Normally a shower washdown with clean water and a decontamination solution is the norm. It needs to be understood that all belongings on the person like watches, phones, jewellery, documents and clothing may need to be discarded and either incinerated or separately decontaminated. Therefore, a fresh set of clothing including footwear may need to be provided to those undergoing decontamination. Decontamination logistics are intensive and need to be planned with care. It is also recommended that all high-risk facilities and critical infrastructures maintain an on-site decontamination centre

suitably located after threat appreciation. Necessary logistics for such a decontamination centre should be the responsibility of the high-risk facility and critical infrastructure. Open areas, public parks and vacant plots can be earmarked for decontamination areas.

- **Individual Decontamination Kits.** As with the protective kits, a similar number of personal decontamination kits should be catered for at all high-risk facilities and critical infrastructures. These are small easy to use decontamination pads with powder substances. Such personal decontamination kits are also needed by all stakeholder response and intervention teams. Sanitiser sprays and gels can also be included for decontamination of personnel and equipment.

- **Medical Management.** CBRN incidents can lead to hundreds of casualties. Many victims may need critical care and careful yet immediate management. Key issues required to be addressed would include:
  - **Triage.** This is the procedure to identify the victims requiring prioritised care. Doctors and paramedics are trained to conduct triage in mass casualty situations in the field. All hospitals and clinics need to prepare for CBRN incidents and cater for adequate Triage equipment. Suitable training if required may be imparted under the Continuing Medical Education (CME) programs.
  - **Evacuations.** Detailed planning is required for the evacuation of victims from the incident sites. An adequate pool of available ambulances needs to be maintained as a database with the Metropolitan Administration. A dedicated communication plan to requisition ambulances with paramedic staff must be worked out. A well thought out private-public coordination for such ambulance and staff provisioning must be instituted. Such drills must be practised. Metropolitan planners must also work out routes of evacuation (including alternate ones) from all high-risk facilities and critical infrastructures.
  - **Hospital Preparedness.** Careful planning and preparation are needed to enable hospitals and clinics to manage CBRN casualties. Hospitals would be called upon to deploy field medical aid centres near the incident site(s). Tents, field operation and treatment facilities, equipment like resuscitators and CBRN casualty pods are required to be catered for. Doctors and paramedics must practice rapid deployment of such field facilities and hospitals must train the support staff for the same. Every city has a medical helpline. Such facilities should have the capacity to switch to a CBRN mode on the requirement. Necessary additional

supplies and modification kits should be provisioned.

- **Mass Crematoria.** As the fatal casualties would be toxic and contaminated, there may be a need for the contained disposal of these cases. As such, special crematoria may be earmarked for such procedures. In some countries, mobile container-based crematoria are provisioned for onsite disposal.

- **Control Agency and Incident Command.** CBRN situations need multi-agency response and interventions. You cannot have all stakeholders operating in their own way without coordination. There is also the need for centralised command for effective operations. It is necessary to have a central control agency under the Metropolitan administration. This agency should coordinate all preventive and preparatory actions including planning and follow-on tasks. Further, for onsite operational effectiveness, an Incident Command Centre is needed to be set up. Guidelines for an Incident Command have been issued by the NDMA.
- **Guidelines and SOPs.** For the smooth and seamless functioning of all the stakeholders in a CBRN situation, there is a need for setting guidelines and Standard Operating Procedures (SOPs). The Metropolitan agency made responsible for CBRN incident management should be tasked with developing and disseminating such guidelines and SOPs amongst all stakeholder agencies. Many States and Districts have developed SOPs based on guidelines issued by central agencies and ministries.
- **TTE and Mock drills.** For effective operationalisation of intervention and response plans, there is a need for practice. Especially as there are many stakeholder agencies involved. Based on the guidelines and SOPs, regular Tabletop Exercises (TTE) must be conducted based on different CBRN contingencies which are possible. Once the plans are discussed and played through in TTEs, finalised contingency plans need to be developed. Such plans need validation on the ground. For this, mock drills are a must. It should be ensured that all relevant stakeholders participate in such mock drills. Due diligence and realism, within safety and security limits, should be built in to suitably train the personnel.
- **Review mechanism.** No plans and situations are permanent. Threats are constantly evolving. So is the technology and newer equipment. It is, therefore, necessary to review the plans and training procedures periodically. Guidelines and SOPs may need revision. Such reviews are essential to maintain optimal capabilities to prevent and if required effectively respond to a CBRN incident.

Conclusion

Smart cities need to be smart secure too. Many cities in Western Europe have systems in place for CBRN risk mitigation. It may be said, and is true, that most regulations for the above system exist even in India. However, implementation has been a bane. Residential areas have enveloped industrial zones and vice versa. Industrialisation and uncontrolled urban development have created an ever-growing range of CBRN threats. Metropolitan authorities, the various stakeholder agencies and the public at large need to be sensitised and prepared to prevent such threats. At the same time, due precautionary measures and mitigating procedures need to be comprehensively instituted to save lives and prevent escalation of CBRN incidents. It calls for a structured program cooperative initiative duly guided by experts in the field. This paper is a suggested way forward and an appeal to Metropolitan, District and State authorities to take note and enable our cities. Let us make our cities CBRN secure.

ABOUT THE AUTHOR

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