

Disaster Specific Approaches: Chemical, Biological, Radiation and Nuclear (CBRN) Disasters

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Abstract – The probability of a NBC emergency/disaster is quite low, however it can't be completely ruled out. Consequent to the National Disaster Management Act, 2005; the raising of NDRF has brought about a paradigm shift in the way the country now plans to respond to a disaster situation. However, despite all the enunciated measures, the likely commitment of the Armed Forces in fighting the disasters in the country continues to remain irrefutable.

Even though the NDMA mandates the status for secondary responder for the Armed Forces, they may in certain situations, continue to remain the sole instrument of launching relief operations given their reach, size & resources. However, due to complex nature of CBRN (Chemical, Biological, and Radiation & Nuclear) emergency & the extent & pan India footprint of Armed Forces can contribute very effectively to mitigate a CBRN disaster. It further underlines the requirement of Armed Forces in support of civil administration to fully prepare for response to CBRN disasters irrespective of status/obligation of responders.

The paper presentation will cover the following nuances:

- a) **CBRN Emergencies/Disasters**
- b) **Levels of Disaster**
- c) **Role of various stakeholders**
- d) **Initial Actions**
- e) **Media & Assistance from Civil Administration**

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BACKGROUND

Since time immemorial mankind has been continuously exposed to naturally occurring ionizing radiation. However, it was only towards the end of nineteenth century that human beings became aware of it, when x-rays were discovered in 1895 by Wilhelm Roentgen and radioactivity in uranium salts was discovered by Henry Becquerel in 1896. This was followed by the discovery of nuclear fusion by German chemists Otto Hahn and Fritz Strassman in 1939 and the demonstration of a self-sustaining chain reaction in natural uranium oxide in a graphite pile by Enrico Fermi in 1942. Since then there has been an exponential growth in the application of nuclear

science and technology in the fields of power generation, medicine, industry, agriculture, research and defense. Today there are about 440 nuclear reactors operating in 31 countries, meeting 60% of world's electricity needs, with contribution in some countries ranging from 20% to 70%.

As on date 17 power reactors and 5 research reactors are in operation in India, 6 power reactors are under construction and plans exist to set up Thorium based reactors to meet the ever increasing energy needs. Further, India uses nuclear radiation in a variety of applications in the fields of medicine, industry, agriculture and research. The phenomenal growth in the applications of radioisotopes and

radiation technology has helped in improving the quality of life of human race. India is also one amongst the 7 declared nuclear weapons states which uses nuclear technology for strategic purposes.

It is a matter of a fact that applications of nuclear energy / radioisotopes are among the world's best regulated ones, with the highest safety records because of the best safety practices and standards followed in these applications across the world. An analysis with merely 140 major radiation related accidents that have occurred worldwide during the period 1960 to 2005, shows that these have resulted in about 150 fatalities attributable to radiation a number which is quite small though not desirable as compared to more than 5000 fatalities in coal mine accidents or 1.2 million deaths in automobile accidents taking place world over every year.

Nuclear plants, in general, adopt a defence in depth approach and multiple physical barriers to ensure that radioactivity is contained at all times. However, if finite number of low probability events are postulated to occur, releasing radioactivity into the environment. Consequently, emergency preparedness and response plans are in place to cope up with nuclear or radiological emergency ranging from minor incidents like a small spillage of radioactive material to a major nuclear accident releasing large scale radioactivity (like Chernobyl) in the public domain. There could also be malevolent acts like explosion of radiological dispersal device commonly known as 'dirty bomb' by a terrorist group or large scale nuclear disaster resulting from nuclear attack by an adversary. The applications of radioactive materials by virtue of their widespread applications, the availability of radioactive sources has become more common which can lead to their possible use for malevolent purposes. As the programme on nuclear power generation expands along with a similar growth in application of radioisotopes in the areas of medicine, industry, agriculture and research (along with associated security threats as mentioned above). It is essential that a holistic emergence/disaster management plan be in place and practiced to respond to all such eventualities in the days to come.

The probability of CBRN disaster is quite low, however, it cannot be completely ruled out. The National Disaster Management Act 2005 recommends architecture for disaster management in which the National Disaster Response Force (NDRF) has been nominated as the first responder while the Armed Forces have been mandated as secondary responder. However, due to complex nature of CBRN emergency and the geo-prevalence of Armed Forces, the Armed forces should be prepared to be nominated in a key role during the effort to mitigate a CBRN disaster. However, despite all the enunciated measure, the likely commitment of armed forces in fighting the disasters in the country continues to remain irrefutable. Even though the NDMA mandates the status of

secondary responder for the armed forces, they may in certain situations, continue to remain the sole instrument of launching relief operations, given their reach, size, potency and resources. However, due to complex nature of CBRN emergency armed forces organizations extent and geo-prevalence the forces will be prepared to the nominated in a key role during the effort to mitigate a CBRN disaster. It further underlines the requirement of armed forces to remain fully prepared for response to CBRN disaster irrespective of status/ obligations of the responders.

CBRN Disaster Scenarios

Any radiation incidents resulting in or having a potential threat in exposure to or contamination of the workers or the public in access to the respective permissible limits can be termed as nuclear radiological emergency. These emergencies which are usually well within the coping capabilities of the plan / facility authority along with the neighboring administrative agencies be it civil or military (if required) can be classified in the following manner:

- a. An accident taking place in a nuclear facility of the nuclear fuel cycle including the nuclear reactor or in the facility using radioactive sources leading to a large scale release of radioactivity in environment.
- b. Disaster in nuclear facility either due to manmade/natural, technical causes. There would be a possibility of rendering assistance in controlled collateral damages.
- c. Disaster/terrorist attack using radioactive materials by any anti-national elements or terrorist using a 'dirty bomb' i.e. radioactive dispersal device (RDD).
- d. Chemical leak in an industry/installation, a leak of a toxic industrial chemical/material (TIC/TIM) shall require assistance from the armed forces in assistance in the civil administration to contain collateral damages.
- e. Disaster/Terrorist attack using chemical agents: A terrorist group may use lethal chemical agents in dense population centres.
- f. Disaster/terrorist attack using a biological agent: Terrorist groups or anti-national elements may use a biological agents in population centers unlike a chemical agent attack, the effect of a biological agent is delayed and requires incubation time.
- g. Aftermath of a Nuclear attack: This contingency is likely to arise only in the case of hostilities with our adversaries. In such an eventuality, the operational constraints

preclude the employment of armed forces to assist the civil administration. The primary responsibility to respond to a nuclear attack in the civil domain during hot war will be that of the civil administration. However, depending on the scenario some assistance could be requisitioned from the armed forces.

- h. Accidents during transportation: The accidents or leaks during transportation of CBRN material as it happened in the Delhi airport cargo material in the year 2016, the possibility of such repetitions is quite high.

Categorization of Emergency

The international Atomic Energy Agency (IAEA) classifies nuclear and radiological emergency under 2 categories as under:

- a. Nuclear Emergency: It is an emergency situation in which there is, or is, presumed to be a hazard due to the release of energy along with radiation from a nuclear chain reaction (or from the decay of products of a chain reaction) discover the accidents in nuclear reactors criticality situations in fuel cycle facilities, nuclear explosions, etc.
- b. Radiological emergency all other emergency situations which have the potential hazard of radiation exposure due to decayed radioactive isotopes are classified as radiological emergencies.

Levels of Disaster

The national Disaster management Plan (NDMP, 2016) categorizes disaster situations into 3 levels. They are:

L1 & L2 are managed within the capability of resources of district and state level respectively.

L3. The level L3 refers to a nearly catastrophic situation or large scale disaster that overwhelms the district and state authorities. If the situation requires direct assistance from central government or the deployment of central agencies, the central government will provide all necessary support irrespective of the classification of disaster from L1 to L3.

Existing Infrastructure to Combat Such Disasters

Role of NDMA/NDRF

NDMA is the apex body governing all aspects of disaster management in the country. However, for CBRN related incidents, the National Crisis Management Committee (NCMC) shall assume responsibility for coordinating all efforts and relief. At the National level NDMA shall authorize NDRF to immediately respond to a CBRN disaster situation. NDRF has total 12 battalions each with 6 companies, located in various parts of the country to handle CBRN incidents each battalion is equipped and trained with 2 companies on CBRN disasters.

Role of Armed Forces

To deal with the peace-time mitigation of CBRN incidents and disasters, ministry of defense has created CBRN Quick Reaction Teams/Quick Reaction Medical Teams drawn from armed forces trained manpower. In addition other elements of the armed forces are constantly trained and sensitized with CBRN exposure so that they can have a dual task performance in case of peacetime disaster to help the civil administration. These teams have been equipped with the state of art equipment and medical facilities to meet any challenges at a very short notice.

Important Issues which Merit Consideration

Status of Equipment: The equipment as held by civil administration is not only grossly inadequate but needs constant up gradation and continuous maintenance to meet the challenges. The training of civil administration including medical staff, youth organization like NCC, Scouts, NSS and NYKS and NGOs has to be coordinated and well-rehearsed at regular intervals.

Limited Resources for large-scale management

The strength, quality and technological compatibility of equipment held by civil administration as well as armed forces needs to be addressed at priority as they are not only primitive in vintage but grossly inadequate in terms of population to relief ratio. As the present resources precludes large scale management of evacuation, crowd control, traffic management, medical treatment and large scale decontamination. For this, the government should ensure that the civil administration utilize its own resources, resources of NDRF, and NDMA or seek assistance from other agencies including NGOs who have to be taken on board while carrying out the rehearsals and the mock drills in peace time.

Requirement of Additional Resources

Disaster incidents are likely to be marked by law and order situations. Therefore, as part of our philosophy the civil administration at least at state capital levels should cater for additional nuclear/radiological facilities medical assistance trained and semi-trained manpower which can be culled out in the form of Army Veterans, retired police personnel, youth organizations like NCC, NSS, NYKS which will substantiate the heavy demand and befitting response in the disaster situation if so arises. The additional resources will be required to address law and order situation, traffic management, relief, food management and documentation of the affected population. These people will not be utilized in contaminated areas due to non-availability of protective clothing and equipment but will surely relieve the combat manpower at ground zero to provide immediate help and succor.

Maintenance of Database of CBRN establishments

All district headquarters should prepare a database of all CBRN related establishments viz. chemical and pharmaceutical industries/plants etc., in consultation with armed forces so that the resources are dovetailed to synergise the national effort for intimate and responsive relief immediately.

Use of Armed Forces Equipment for CBRN Disasters

The civil administration and the armed forces should work in sync with sole aim that the civil administration officials and other stake holders are familiar with the characteristics and capabilities of various organizations, institutions and equipment, so that maximum benefit can be derived to help the affected population the armed forces should be well aware of civil administration functioning and the civil administration should also know the potential of help which can be rendered by armed forces during such crisis like situations.

Limitations of CBRN Equipment

The equipment available with the armed forces affords protection only against known war gasses or chemical or biological agents and not against poisonous gases, toxic industrial chemicals or toxic industrial material. Also, the individual protective equipment (IPE) does not afford protection against radiation hazards. The limitations of equipment currently held with the armed forces must be borne in mind by the civil administration while employing armed forces in CBRN emergencies.

RECOMMENDATIONS FOR MAKING INDIA MORE RESILIENT AND CBRN DISASTER FREE

The basic regulatory authority of all activities is Department of Atomic Energy (DAE) as the nodal

agency for providing necessary technical inputs to the national or local authorities for responding to any nuclear or radiological emergency. In public domain MHA is the nodal ministry for any kind of CBRN emergency. In the event of any nuclear or radiological emergency in public domain, C M G is immediately activated and it coordinates with the local authority in the affected area and all the connecting authorities at the centre like NATIONAL CRISIS MANAGEMENT COMMITTEE, National Disaster Management Authority and National Executive Council to ensure that the necessary technical inputs are available to respond to the nuclear/ radiological emergency. These bodies should have regular meetings say once a quarter with all stakeholders so that during peace they can understand the capabilities and charter of duties of each other. The Atomic Energy Regulatory Body (AERB) which oversees nuclear and radiological safety in the country, has the powers to not only license the operation of a facility but also the power to shut down of any facility that violates its guidelines. The AERB has been playing a very crucial role in the prevention nuclear and radiological accidents by ensuring that proper safety design features and operating procedures in all nuclear and radiation facilities are in place.

REHEARSALS OF EMERGENCY PLANS

As per statutory requirements, the local district administration is responsible for drawing up and rehearsing the offsite emergency plan in coordination with the facility operator. It is also mandatory for the power plant or industrial unit operators to periodically rehearse these plans by way of exercises and based on the feedback and experience, take corrective measures. As the first stage of trigger mechanism, C M G, D A E, and resources agencies are alerted even when a plant or site emergency exercise is conducted. The Armed forces should be factored in in all such exercises and the youth organizations like N C C, N S S, N Y K S Scouts and Guides also, this will facilitate better understanding and coordination during crisis situation.

All emergency plans should be practiced with the radiation treatment facilities available in the vicinity for the safe use of sources and safe operation of facilities which are to be adopted and followed by all the facilities using radio isotopes/ radiation sources. These include safe design of equipment, its operation within the permissible range of parameters and availability of suitably qualified radiological safety officer (RSO) who is responsible for ensuring safe practices. The prescribed procedures also describe what will be done in the event of any radiation emergency. The CNG, DAE would also be available to direct technical resources of D A E to the accident site and to assist the local authorities like D D M A and S D M A in handling emergency situations.

Emergency Response to Transport Accidents

The transport of radioactive material and emergency response plans for accidents during their transportation. The consigner of the material is responsible for ensuring that the prescribed safety procedure are followed. The A A R B safety code covers the design of the transport container, its handling and loading, procedures for transporting and unloading including the procedures to handle any accident enroute. The standing operating procedures also indicate what will be done in the event of radiation and emergency, the precautions to be taken and the agencies to be notified, etc. The cargo handling staff at airport and seaports have to be factored in the awareness seminars, mock drills and exercises.

Medical Preparedness

A few doctors in all hospitals be dedicated and given the necessary training in the medical management of radiation emergencies like all nuclear power plants and the Bhabha Atomic Research Center (BARC) are equipped with radiation monitoring instruments, have personal decontamination centers and necessary stock of medicines and specific decorporation agents for typical radio-isotopes. More hospitals in the country on regional basis have to be equipped with the facilities required for bone marrow transplantation, which will be useful in managing cases of acute whole body irradiation. Further doctors from the armed forces Viz Army, Air Force, Navy and Coast Guard units and other paramilitary organizations in the country are to be trained in the medical management of CBRN. The medicos and paramedics at various medical colleges should have a dedicated days of CBRN and exposure treatment right at MBBS level.

Capacity Building and Development

In addition to the medical staff and the training teams of NDRF the training of first responders and training of trainers are being imparted by BARC. BARC is also providing active help in imparting help to quick reaction teams of paramilitary forces. It has also been regularly conducting week long training courses in planning and preparedness for response to radiological emergencies since 1999. The college of Military Engineering CME Pune for Defence Chemical, Biological, Radiological and Nuclear officers during which the participants are also trained in aerial survey for quick assessment of radiological impact in case of a nuclear/radiological emergency. Some units of Defence Research and Development Establishment (DRDE) are also imparting training to these personnel in nuclear emergency preparedness. The armed forces are also training their officers and men and the nursing staff in dealing with CBRN Disaster like situations. The officers and men are being given

exposure on these basic military training level, junior command level, senior command level and at higher command level.

Research and Development

Areas like security of nuclear facilities as well as that of nuclear sources and radiation monitoring in the public domain need periodic review under ever-changing threat perception and be strengthened further so as to prevent radiation emergencies in the public domain. Also, there is a need to review the periodic effectiveness of emergency response system in the public domain, keeping in view the new dimensions of threat perceptions for which certain issues need to be addressed over a period of time.

Education and Knowledge Management

At present no education is imparted at any level on nuclear/radiological emergencies in the national educational system. It goes against one of the basic concepts of good emergency response, which envisages that the culture of preparedness has to be imbibed right from childhood in all sections of the society. The basics of radiation, radioactivity and the use of nuclear radiation in day-to-day life (with its beneficial aspects) should be taught in schools and colleges. Once people are sensitized to this subject, it will help in removing prejudices/misconceptions of the general public about nuclear radiation/programmes and they will treat a nuclear/radiological emergency like any other type of natural or man-made emergency. Further, there is presently no mechanism for maintaining a knowledge base or case studies in the public domain on the events of previous emergencies and their consequences. As a result, the lessons that should have been learnt from the handling of those emergencies have been lost sight of.

Enhancing Public Awareness about Nuclear Radiation Hazards

Lack of public awareness is a major constraint in handling and objectively responding to these emergencies. To overcome this, sincere and concerted efforts are needed to create awareness amongst the general public with the target audience of school and college students, teachers, technocrats and government officials.

Regulatory and Enforcement Issues

The A E R B, the national regulatory authority, has been regulating the nuclear and radiation facilities in the country very effectively and has, over the years, issued a large number of codes, standards and

guided. These cover the various activities relating to nuclear fuel cycle as well as for radiation applications in medicine, industry, agriculture and research. In the event of the private sector getting involved in the nuclear power programme, it might be required of the regulatory authority to ensure that the necessary knowledge base exists in the concerned private industry for building and operating the nuclear facility as per the stipulated safety standards of the A E R B.

Intervention Levels and Action Levels in case of a Radiological Dispersal Device or Nuclear Disaster

A question that is frequently asked is about the radiation dose levels at which intervention is required for various actions (like sheltering, iodine, prophylaxis, evacuation, etc.) in the case of nuclear disasters. The availability of this information on the avertable dose level is important not only for the public but also for the rescue and relief workers. In addition to the intervention levels, the action levels that will be needed to control the consumption of contaminated food items in the affected areas is another issue. These values are not available either for an R D D or a nuclear disaster and are needed to be generated because these are essential in respect of both (i) the members of the relief and rescue teams, and (ii) the public. In fact several major metros and other vulnerable locations will need to have E R Cs established in their areas. Local civil defence, police, fire brigade, hospitals and other agencies also need to develop liaison with these E R Cs.

Strengthening Monitoring and Detection Systems in the Public Domain to Control Malevolent Activities

There is an immediate need to strengthen the mechanisms to detect such occurrences. At present, there is no mobile monitoring system available with law and order authorities which will warn them of any significant/abnormal rise in the background radiation level in the public domain. The establishment of such a monitoring system on priority is considered highly desirable, to detect any unauthorized presence or movement of radioactive material in the public domain.

Strengthening Border Controls and Enhancing Security

There can always be a possibility of some radioactive sources going 'out of control' in some country and from there entering our country, either inadvertently or deliberately. Instances of the first type have occurred in the past in the form of the sources being present in the scrap imported by certain domestic steel foundries in our country. In addition, there is also the potential that radioactive materials might be smuggled into the country by anti-social elements, terrorist organizations and state-sponsored activists. Presently, there is no monitoring system in place at the entry points to prevent such events.

Facilities using radioactive sources need to strengthen their physical protection systems along with proper inventory and control procedures of the radiation sources. In the current security threat scenario, there is a need for enhancing the security of sources at radiation facilities and during their transportation, to ensure that they do not go 'out of control' by any deliberate acts of theft and sabotage and become a potential radiation hazard to the public. A nation-wide capability of Radiological safety officers for managing both R D D related scenarios and large scale nuclear disasters will be considered on priority. At present, no formal system exists in this regard.

Role of the Armed Forces

Because of their preoccupation with defending the nation from external threats, the armed forces are normally not always available to respond to a nuclear disaster scenario. However, for any major nuclear accident where the situation is beyond the coping capability of the civil administration, the services of the armed forces may be called for to take over several critical operations related to response (i.e. rescue and relief); rehabilitation (i.e. evacuation and sheltering) and reconstruction activities, including the immediate restoration of essential infrastructures like communication, electrical power, transportation, etc. For such operations, specially trained teams in the armed forces will always be available from within their existing sources. Civil-military coordination will be developed for such purposes so that especially trained and rehearsed teams of the army can be inducted to assist the civil administration as and when called for and available.

Prevention of Radiological Dispersal Device and Improvised Nuclear Device Instruments

Highly sensitive detectors/dirty bomb detectors capable of detecting the smuggling of radioactive sources or explosives will be installed by M H A at all entry and exit gates of the various possible routes (airports, sea ports, border crossing areas, etc.) to prevent radiological terrorism. On detection of radioactive materials, these detector systems will generate an alarm on real time basis. All nuclear facilities will also have monitoring systems installed at the entry and exit gates to detect unauthorized movement of radioactive materials. Police patrolling vehicles will also be provided with portable radiation monitors to detect the presence of unauthorized sources in the public domain.

Mitigation Measures

Defence in Depth helps to ensure that the three basic safety functions, viz.: controlling the power, cooling the fuel and confining the radioactive material, are preserved and that even in case of an emergency, radioactive materials do not reach the public or the environment. The defence in depth

concept is centred around several levels of protection, including successive barriers, preventing the release of radioactive materials into the environment.

While the design and operation of nuclear power plants ensure that the likelihood of an accident is very small, still such failures are postulated and engineered safety systems for reducing damage and confinement of radioactivity are provided to minimize the impact of these failures.

For nuclear facilities, the inbuilt safety measures, including biological shields, safety systems and interlocks, safety audits combined with operations and administrative safety procedures, mitigate the consequences of accidents. Periodic regulatory inspections by the AERB and

surveillance by plant safety personnel are carried out to ensure that a mitigation mechanism is in place.

Goals of Emergency Preparedness

The practical goals of nuclear emergency preparedness are:

- (i) To reduce radiation-induced health effects by preventing, to the extent possible, the occurrence of severe deterministic effects in workers and in the public.
- (ii) To limit, to the extent practicable, the occurrence of stochastic effects in the population. It should be borne in mind that actions to reduce the risk of stochastic effects beyond a point (e.g., relocation from an area with insignificant levels of dose or contamination) will sometimes do more harm than good. Taking protective action significantly below the generic international guidelines for intervention and actions for protective measures levels could do more harm than good.

The level of preparedness for response will be commensurate with the severity of the nuclear/radiological hazard potential. Since the response actions during C B R N disaster scenarios are quite different from those needed for natural and other man-made disasters, C B R N-trained battalions of NDRF (presently located at Greater Noida, Kolkata, Talegaon in Pune and Arakonam in Chennai) must always be available on an emergent basis.

The civil defence authorities will work out their overall mechanism for responding to various disasters and take the assistance of D A E/D R D O as well as C B R N-trained N D R F staff in training and equipping their

personnel with regard to handling radiation emergencies/disasters. The standard list of instruments, equipment and protective gear necessary for the various response teams will be drawn up in consultation with D A E, with full technical specifications (the list will be updated periodically) and procured by the concerned S D M As and D D M As in advance for the response actions.

Role of the Armed Forces in Training

While N D M A and M H A have co-opted suitable members from the Ministry of Defence in all the committees, similar action must be taken by the state governments and district authorities at their respective locations. The armed forces will also gear up their nuclear disaster preparedness so that they can be inducted in the event of nuclear disasters. The evaluation of any exercise will identify areas of emergency plans and preparedness that may need to be improved or enhanced. It will be the responsibility of the nuclear facility and the district authority to review the evaluation report and ensure implementation of the corrective measures recommended by the evaluators. Training would have to be imparted by specified trainers to other stakeholders from the district, state and central authorities. In the process of their being trained to handle other types of natural and man-made disasters, they will also be sensitized on the special aspects of nuclear/radiological emergencies (while highlighting some common features like sheltering, evacuations, etc.)

Strengthening the Network of Emergency Response Centres

In addition to the E R Cs established by B A R C, it is essential that additional E R Cs with the necessary trained personnel and equipped with appropriate radiation detection instruments and PPG are set up in all the major cities and other vulnerable locations.

The police being the automatic first responders, these additional E R Cs will be located at the District Police Control Rooms (DPCRs/District Police Lines (DPLs)). Immediately on the occurrence of any major/near major explosion, personnel from the nearest E R C will move in a police vehicle along with radiation detection devices and PPG for inspection of the site in the normal course and as part of the SOP. On detection of any enhanced level of radiation whatsoever, they will immediately report the same to DDMA from where the necessary instructions for handling of such emergencies will originate. The response actions will, inter alia, include calling experts from the nearest DAE/DRDO establishment or from any of the other E R Cs set up by BARC. If any NDRF battalion or Army formation is

located nearby, their assistance will also be immediately requested for, if required. The responsibility for setting up these additional E R Cs will be from the existing manpower and that of the state government. The financial resources for these will be made available by the center. N D M A will organize provisioning of the entire financial requirements for preparation of such emergencies as part of a mitigation project.

The establishment of these additional E R Cs including the procurement of the necessary monitoring instruments and PPG and training of the first responders from the police force will be completed within a period of three years at the outer limit.

Emergency/Disaster Management for Metros and Important Cities

All the major metros and certain other bigger cities can be considered vulnerable from a nuclear emergency/disaster point of view. A list of monitoring instruments and other equipment required for this purpose can be worked out with the help of D A E. The training of first responders at these places should be taken up immediately. The civil defence set-up of these cities will also be activated. Detailed operational plans followed by SOPs will be prepared for all these locations.

To start with, an effort will be made to cover all cities with a population of 20 lakh or more in the first phase by the S D M As/S E Cs and D D M As concerned, in consultation with D A E/D R D O . The satellite towns around the target cities will also be considered as available resources to preparing them to provide the necessary assistance in the event of any nuclear radiological disaster. This is most important for the metros in the country. The coverage will be progressively extended to include cities with population of approximately 10 lakh or more after 3 years and on completion of the first phase.

Adequate funds will be earmarked for the development/up gradation of a large number of emergency response centers with sufficient number of monitoring systems and protective gear, training of emergency response teams and first responders, etc. States/UTs will be adequately assisted by N D M A and the Planning Commission in this matter.

CONCLUSION

In order to obviate any C B R N disaster in the years to come, we must be prepared despite all the structures being in place at various levels of administrations involving all stake holders in order to synergise the resources be followed, the impact of such disasters is going to be phenomenal on society be it physical, or emotional. The preparation of disaster management plans and financial arrangements have to be matched and suitably in place at all times with a caveat that

they need to be revised from time to time. The responsibilities of key stakeholders recognizing the enormity and crucial nature of C B R N disaster the officers and staff needs to be sensitized and rehearsed in the drills and practices. The collector / magistrate of the affected district will be personally responsible to undertake the relief and rescue operations, he or she will not delegate his duties to anyone else. The D M will nominate an incident commander to supervise the operations. The trained manpower should be pooled in and further reservoir of trained people be catered to enhance the relief and rescue base. The trained manpower of Armed Forces be also factored in such drills, mock exercises and rehearsals. Capacity development should not be lost sight of as this will strengthen the system and disaster management organization. A reliable and green field robust communication should be in place to deal with such crisis like situation. The last mile connectivity has to be ensured and special teams thus formed be in communication with the district authorities. Sufficient inventory of equipment and clothing be made available. Adequate shelters , I E R M O N systems for strengthening the real time information be established.

Education and awareness generation programmes for the community should be conducted for public to get educated. Medical preparedness plan should be comprehensive and in sync with medical layout of city and towns. Existing medical manpower and facilities are inadequate to handle large scale disasters to handle radiation injury cases establishment/upgradation of primary, secondary and tertiary care hospitals which can handle sufficient number of people affected during nuclear emergency should be taken up by ministry of health and family welfare. A concerted approach by all concerned viz. NDMA, SDMA, DDMA, MHA, DAE and MOH&FW and State as well as District Health authorities is necessary to network medical professionals, training them in management of radiation injuries maintaining an upto date database of such expertise and developing mechanism to tap this expertise in the event of an emergency.

Training of Various First Responders and Administrative Personnel involved in disaster management should be imparted at regular intervals at various institutes and centres. Training programme for medical professionals for treatment of radiation injuries, trauma management, formation of QRMTs/MFRs along with maintaining sufficient stock of essential medicines and database for experienced medical professionals should be taken up by MOH&FW on priority basis.

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