Review Paper:

Risk Management of Technological Accidents triggered by Natural-Hazards (Natech): A Review of Relevant Indian Legislation

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Abstract

The ill-effects of technological sites on the environment have been researched substantially across the world with particular reference to pollution. However, the threats posed by the environment to technological sites have rarely been studied. Such events, where natural forces trigger technological accidents, are called Natech accidents. It has been observed that developed countries are aware of this emerging hazard and they have responded to it by creating various legislative frameworks for managing Natech risk. In contrast, in developing countries, it has not yet received due attention.

The present study has been done to understand the Indian perspective of the legal framework for Natech risk reduction. The study revealed that India has an elaborate legislative framework for disaster risk identification and management. Though there is attention to routine disaster risk, the risk from natural forces to the technological sites is rarely considered. Apart from recognizing natural forces as a threat, no specific legislation is available for Natech risk reduction. A developing country like India must manage the risk posed by natural forces to its technological infrastructure. There is a need for specific legislation to manage Natech risk, which will be an initiating force for the state of the art Natech risk management.

Keywords: Disaster Management, Natech Risk, Indian Legislation, Safety of Hazardous Industry, Risk Reduction Measures, Climate Change.

Introduction

Natech (Natural hazard triggered technological) refers to industrial accidents caused by the impact of natural forces on an industrial installation or industrial area. Technological accidents occur due to the release of any chemical, which is triggered by any natural hazards. A Natech accident can cause an immediate release of hazardous substances resulting in the damage of safety barriers and systems meant for the prevention of accidents. Also, the responders, when trapped in these events are neither trained nor equipped for handling such type of substances[6,14,17]. Therefore, Natech risk assessment is required for protecting and preventing industrial operators from chemical accidents—Natech risk management compromises of proper understanding of the interdependencies of technological systems, human and nature.

Pescaroli and Alexander[33] defined cascading events as, "the dynamics present in disasters, in which the impact of a physical event or the development of an initial technological or human failure generates a sequence of events in human subsystems that result in physical, social or economic disruption". There are particular types of cascading events in which natural accidents can trigger one or more technological accidents. Such technological accidents that are initiated by natural forces are called Natech accidents. Such accidents may result in consequences like fire, explosion, or release of hazardous substances in the environment.

Natech events have affected several parts of the world. A tsunami triggered the worst nuclear disaster of Japan popularly known as the Fukushima disaster that occurred on March 11, 2011, which has been considered as a suitable example of Natech. This was the worst industrial disaster in history as far as the cost of damage control and cleanup is considered from 1917 till 2011 [24]. Showalter and Myers[38] have investigated technological accidents triggered by natural forces in 28 States of America. In their research, they documented that there were "228 accidents resulting from earthquakes, 28 from hurricanes, 16 from floods, 16 from lightning, 13 from high winds, seven from storms and six for other reasons". They called such accidents as "Natech," a portmanteau of the naturally triggered technological accidents [1,4,13,16,31,38,39]

Lindell and Perry[20] document recent releases of the hazardous material triggered by the earthquake in the United States, 1996, "1971 San Fernando 18 releases, 1983 Coalinga 18 releases, 1987 Whittier Narrows 30 releases, 1989 Loma Prieta 50 releases and 1994 Northridge Earthquakes 134 releases"[20]. The Turkey earthquake that

occurred on August 17, 1999, has been considered as the best example of Natech accidents.

Steinberg and Cruz[39] studied this earthquake and found that many industrial sites were affected by the earthquake. They documented 21 hazmat release incidents associated with the earthquake [39]. Fall of the spruce-fir tree because of high wind velocities created many emergencies and blackouts in Italy on September 28, 2003. Earthquake and 1.3m Tsunami resulted in tank fire at Tomakomai City on September 26, 2003 [14].

Storage tanks are vulnerable as they contain a large quantity of material. Chang and Lin[2] have reviewed such accidents related to the storage tanks. They found that during the period from 1960 to 2003, there were 242 accidents, among which 30 % of accidents were caused by lightning. All these events mentioned above have been considered as the results of cascading events, although having low chances of occurrence but when occur, will cause complexity concerning the risk management[28]. A Natech disaster cannot be managed by the routine disaster management system as it has the following peculiarities;

- There is a possibility of multiple simultaneous releases of hazardous materials.
- The natural event may incapacitate existing safety and mitigation measures.
- Resources required for the management of emergency and responses personnel may remain engaged in dealing with natural disaster and may not be available for management of technological accident.
- Natural disaster may hamper emergency response to the technological accident.
- Effects of a hazmat release may get exacerbated by a natural disaster.
- Stringent design standards can be exceeded by a severe disaster[3].

The research community generally considers the Natech event as a rare event and cascading effect of a natural disaster. Climate is changing and the modern world faces more and more stringent climatic conditions which can increase the Natech frequency, making it no more a rare event. There is a need to review the typology of disaster and acknowledge that the Natech risks exist.[7,10,11,18,19,25–27,30,34,35,37] Also, multi-hazard concepts have been evolved which involve the threat factors to produce the trigger event of a disaster. The models have been generated to reduce the risk in most populated regions, but their use is still limited [12]. The identified research gap has led to the initiation of assessment of Natech risk assessment, which has involved the initiation of risk analysis in Europe and other regions across the world for creating tools and protocols for risk assessment.

For addressing the Natech risk assessment, developed countries have formulated different acts and legislations. They do follow the laws and regulations strictly for reducing Natech risk. The developed countries are aware of the emerging hazard and they have responded to in recent decades by creating various legislative frameworks. However, in countries such as India, on the other hand, this awareness and legislative response pertaining to Natech are seemingly missing factors.

Article 9, Domino Effect, of Seveso III guidelines of the European Union, mandates the Member States to "identify all establishments where the risk or consequences of a major accident may be increased because of the geographical position, the proximity with each other and their inventories of dangerous substances". Once major accident hazard installation has been identified, a member state has to ensure that, "the operator of the establishment shall take into account the nature and extent of major accident hazard in their Major Accident Prevention Plan (MAPP), safety systems, safety reports and internal emergency plans, as appropriate". They are also asked to keep the nearby public well informed.

Further, Article 13, related to land use planning, also asks the members "to ensure that the objectives of preventing major accidents and limiting the consequences of such accidents for human health and the environment are taken into account in their land-use policies". Annexure-II, Safety Report, clause number four, asks for "a detailed description of the possible major-accident scenarios". It asks for the probability of occurring as well as the conditions under which major accidents may be triggered by the domino effects or natural causes, like earthquakes or floods[53].

Natural Risk Prevention Plans (RPP) of France came into existence by Article L.562-1 of the Environment Code on February 2, 1995. The development of RPP results in zone maps. This zone map, a Natech risk reduction tool, is used for, "prohibitions and restrictions for the new installations, prevention, protection and safeguard general measures, special measures for existing installations". A new law, no. 2003-699 of July 30, 2003, establishes rules to give compensation for the damage caused by the Natech event. This law mandates that prevention plans have to be made not only for natural risk but for technological risk also[1].

Decrees 210-1254 and 2010-1255, 2010 of France created a zone system for industrial establishments, which takes into account seismology of the area. Industrial establishments are divided into two normal risk and special risk for Natech risk identification and facilitation emergency planning. Establishments falling in the second category need to guarantee that their structures are mechanically strong to withstand ground acceleration, specific to the seismic zonation. Such facilities should sufficiently be robust to ensure the containment of hazardous material [31].

In Germany, the Bavarian State Department of the Interior promulgated a Decree NR. ID4-3041-C/71 (AllMBl P. 362)

on April 19, 1991. This decree mandated early warning to the population for the upcoming storm. The Technical Rule on Installation Safety 310, 2012 of Germany requires that the industrial establishment, which has significant potential for chemical accidents, should do a risk assessment for an accident triggered by the flood. They need to consider increased flood risk because of climate change and take necessary risk reduction measures [1,38].

The United States has also recognized the Natech hazard and various precautionary measures are in the legislation of different States. The Association of Bay Area Governments (ABAG) recommended the specific risk reduction precautions. They published a guide in 1990, "Hazardous Materials Problems in Earthquakes: A Guide to their Cause and Mitigation". They were creating a list of various failure modes and disseminated learnings from the Loma Prieta earthquake. They also recommended migratory measures like "secondary containment structures, the use of seismic restraints, earthquake-resistant structural designs for tanks and pipeline support". The California Accidental Release Program (CalARP) explicitly requires consideration for earthquake-induced hazmat release. It also considers planning for the worst-case scenario of hazmat.[8,31,34,38]

In 2003, the Tokaichi-Oki earthquake, at the refinery, initiated many fires. In response to this Natech event, the Japanese Government amended the law, 'the Prevention of Disasters in Petroleum Industrial Complexes and other Petroleum Facilities'. This law considers earthquake-induced technological accidents.

Accidental releases triggered by earthquakes and tsunamis are included in the amended Japanese High-Pressure Gas Safety Law. These rules require industrial establishments to mitigate the risk of hazardous material release caused by Tsunamis and earthquakes[31]. Though, the specific and comprehensive legislation dealing with Natech risk is lacking, nevertheless, the lessons learned from past Natech events can be reflected in relevant Natech legislation [15].

Appropriate preventive measures, along with response mechanisms, must be developed to mitigate the impacts of the Natech disaster. National level Natech risk assessment has also been evolved for checking the potential risk hotspots that require attention for risk assessment. Natech risk has been made mandatory for some of the hotspots such as refineries, petrochemical complexes, oil and gas pipelines etc. that are more prone to disaster.

It has been revealed that the consequences caused by hazardous materials are the primary factors for causing harm to the environment. Many industrial activities have also been banned to prevent impacts. Hence, there is a need to create suitable legislation for Natech risk reduction. Several legal acts and legislation have been implemented in several countries for addressing the Natech risk assessment. The Government has set several rules that address the industrial activities and other harmful hazards responsible for causing disaster events.

Developed countries have amended their laws suitably but developing countries like India have still evolved little awareness about this relatively new hazard. All the other developed countries are aware of the emerging hazard and they have responded to it by creating various legislative frameworks for managing Natech risk. However, India, on the other hand, is still not aware of the existing laws, schemes and policies laid by the Government regarding the legal framework for Natech risk reduction.

Therefore, the present study has been carried out for the understanding of the hazardous technology that includes hazardous chemicals, 'micro-organisms and generally modified cells' or radioactive substances, which can cause harm to the nearby community resulting in severe environmental pollution. Only these three industries are considered because in case of an accident, these industries can tremendously endanger the life, property and environment of the nearby community.

This study comprises the Indian legislative framework to understand various legislations dealing with the hazardous substance and the subject of disaster management. These legislations have been evaluated for express or implied provisions related to Natech risk management. The objectives of this study are to understand the Indian perspective of the legal framework for Natech risk reduction, need for specific legislation to manage Natech risk and to analyze the correlation between the legislation related to environmental protection and hazardous substances and technology sites.

Methods

The present study implements the legal framework for Natech risk reduction according to the Indian perspective for which the legal framework of other countries had to be highlighted. This study follows a qualitative research approach. Research articles and relevant Acts which could possibly have explicit or implicit mention of Natech risk were reviewed.

Research Articles: The legislation created by other countries for addressing Natech disaster risk was studied mainly by referring to research articles. They have been searched on the internet by using keywords, "legislation for Natech risk" and "legislation for natural hazards triggering technological hazards". Seveso III guidelines of the European Union were studied, as it was important legislation known worldwide for the control of hazardous substances.

The 'Natech disaster' word is composed of natural, technological and disaster, so the study was done in three parts: 1) Legislation related to Environment 2) Legislation related to risk reduction in hazardous technology and 3) Legislation related to disaster management. Legislation

search was done on the internet by using the common prefix, "Act, Rules, Regulations, Notifications and Order" for three categories, that is an environment, hazardous technologies and disaster management. Following are some points regarding the legislation concerning the Natech disaster:

- Natech risk management and related legislation have evolved for protecting individuals from medical and mental health risks.
- This has led to implementing a community health-based approach on the victims of the Natech disaster that fulfils their mental and physical health needs.
- The legislation and Natech risk assessment have involved the justice of healing in the form of recognition and restoration of capabilities.

A total of 30 legislations were identified for the study. Subsequently, four categories were identified, namely, constitutional perspective, environmental legislation, legislations related to hazardous technology and legislation related to disaster management. The study considered the Indian Constitution as it is a supreme law of the land and reviewed every legislation to find out implied or express provision related to Natech risk management. After an in-depth study, the conclusion was drawn about whether Natech risk management has been addressed by the Indian legislation system or not.

Results and Discussion

Relevant legislations have been studied in detail to find the existence of an express or implied Natech related provision. Legislations are available in the public domain in respective departmental websites.

Constitutional Perspective on Disaster Management: India believes in 'Constitutional Supremacy" which means the Constitution is the supreme and all legislative and administrative actions are derived from the Constitution. Though the Constitution of India does not have any explicit provision on the subject of disaster management, many provisions do have implied provisions. Article 51A of Part IVA of the Constitution imposes fundamental duties on citizens of India. Some of these duties are relevant to the broad subject of disaster:

i. "To protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures";
ii. "To safeguard public property and to abjure violence";

Thus, in the true spirit, accident prevention and disaster management are also fundamental duties of citizens of India [52].

Part IV of the Constitution provides for the Directive Principles of State Policy. These principles are not enforceable, meaning they are not mandatory. Nevertheless, they are the guiding stars in the governance of the country. Article 48A provides for "the protection and improvement of environment and safeguarding of forest and wildlife in the country". Any kind of accident or disaster will endanger the environment, so it is a constitutional mandate that every organization and individual should work towards efficient disaster management. The Constitution of India, under Part III, guarantees fundamental rights that are essential for the moral, spiritual and intellectual development of every individual. Broad interpretation by the Supreme Court of Articles 21, 14 and 19 of this part, particularly Article 21, "Right to Life" has laid down various principles required for enjoying full life and freedom with the wholesome environment.[21–23,36,77]

The issue of pollution as a result of technology is addressed in the Constitution, but the issue of the environment affecting technological sites was not expressly addressed. This is obvious because the Constitution creates only basic laws and fundamental infrastructure to govern the country. The provisions regarding disaster management were left to the wisdom of the Government and Authorities. It was expected that they would evolve appropriate policy and administrative framework required for disaster management.

Legislation Related to Environmental Protection: The first special pollution control measure is the enactment of the Water (Prevention and Control of Pollution) Act, 1974. This Act was enacted for "the prevention and control of water pollution and to maintain and restore the wholesomeness of water". It has created water pollution control boards at the central and state level. The duty and function of the boards are to set standards for water and create rules and regulations for prevention, abatement and control of water pollution. After the United Nations Conference on the Human Environment held in Stockholm in June 1972, the need was felt to control and abate air pollution. The Air Pollution (Prevention and Control of Pollution) Act, 1981, was enacted to control and abate increasing air pollution. The Central and State boards which were created under Section 3 and 4, respectively, of the Water Act, 1974 were also empowered to, 'exercise the powers and perform the functions under the Air Act, 1981.[40,76]

Till the year 1986, pollution control legislation was available only for water and air. The need was felt to protect and improve the quality of the entire environment, ensure safe handling of hazardous substances and control and reduce pollution from all sources. So, the Environment Protection Act, 1986 was passed which defines the environment as, "environment includes land, air and water and interrelationship that exists between and among land, air and water and plant, micro-organism, animal etc." The word "include" made this definition open-ended. The implication of this is, whatever we, including us, surround, is an environment.

The Environment Protection Act, 1986 created a giant umbrella; under this visionary Act, various rules are formed

to govern almost every aspect of the environment. Some examples are; management and handling of micro-organisms and genetically engineered cells, chemical accidents, hazardous chemicals, lead batteries, medical waste, municipal waste, hazardous and other waste, construction and demolition waste, plastic waste, E-waste, recycle plastic, ozone layer depletion, wetland conservation, all kind of emissions in the air, water and on land. Even noise is also considered as a pollution[68].

These rules suggest preventive measures for safe handling of hazardous substances, accident notification to the authorities and then mitigating action by the occupier as well as authorities with the help of available resources. Responsibilities and duties to manage hazardous substances are in place.

A total of seven Schedules are attached to the Environment Protection Rules, 1986 of which schedule number two is deleted. The first schedule itself contains all emission standards for 104 different kinds of industries. Not only it provides emission standards, but it also provides quality standards of air and water.[57,58] The Manufacture Storage and Import of Hazardous Chemical Rules, 1989 (MSIHC Rules) were formed under the Environment Protection Act, 1986[66]. These rules define and list hazardous chemicals. Specific definitions of flammable, toxic, explosives chemicals are given. Some chemicals are safe in low quantities but become hazardous if quantities handled are more. For such chemicals, threshold quantities are prescribed beyond which they become hazardous.

An exhaustive list of hazardous chemicals is given in schedule one, two and three. These rules have made detailed provisions for an onsite and offsite emergency plan for the accidents involving hazardous chemicals. Schedule 11 of MSIHC Rules provides for the onsite emergency plan and schedule 12 provides for an offsite emergency plan. This rule covers only "hazardous chemicals" as defined in rule 2(e) and not all "hazardous substances". The definition of a hazardous substance is given in the Environment Protection Act, 1986.

These rules also define Major Accident Hazard Installations and make provisions for the safe handling of hazardous chemicals. Under rule number 10, the safety report is mandatory; and it has to be updated after three years under Rule number 11. A safety audit has to be carried out by an external independent expert person. Rules specify that a safety report has to be prepared according to schedule 8, but how to prepare a safety audit report is not defined. Generally, auditors follow IS 14489 as a standard.

Under these rules, responsibilities of authorities have been fixed under schedule five. Accordingly, the chief factory inspector, now called DISH, Director of Industrial Safety and Health, is the authority for the implementation of these rules for factories. So, these rules, with appropriate modifications, have been made mandatory under the Factories Act, 1948 by some State Governments. For example, in the State of Maharashtra, the Control of Industrial Major Accident Hazard Rules, 2003 has been passed.[64,66]

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was held in 1989. The provisions of the convention were made legal in India by enacting the Hazardous Waste Management Rules, 1989 under the EPA, 1986. New Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016 promoted the minimization of toxic waste generation. Recycle and reuse of waste are promoted and detailed provisions have been made for recycling and reuse of waste. Imports of certain hazardous waste mentioned in schedule six are prohibited, for example, the waste containing Arsenic, Beryllium, Mercury and Selenium. Waste can be imported in India only to recycle and reuse and not for dumping. Elaborated provisions are made for the import and export of hazardous waste [61].

New Biological Waste Management Rules, 2016 divides biological wastes into four classes as against ten types of previous rules which were repealed. These rules provide for scientific management of biological waste. Many new things have been introduced like GPS (Geological Positioning System), tracking of biological waste transporting vehicles, immunization and training of workers, a website showing waste generation data for every biological waste generator and simple colour-coded non-chlorinated bags[44]. Rules are also formed for the management of, "manufacture, use, import, export and storage of hazardous micro-organisms and genetically engineered organisms or cells".

"Micro-organisms or genetically engineered organisms, products or cells" are classified under two major categories; 'animal, pathogens' and 'plant, pests'. Different committees have been created for the management of micro-organisms.

The highest committee is the Recombinant DNA Advisory Committee (RDAC). This committee reviews scientific developments in biotechnology at national and international levels. The prime function of the committee is to recommend safety regulations related to the research and its application in the field. The onsite disaster management plan is the responsibility of the Institutional Biosafety Committee (IBSC) and an offsite disaster management plan is the responsibility of the District Level Committee (DLC) [67].

The Ministry of Health and Family Welfare (Department of Health), Government of India, has issued a notification under the Drugs and Cosmetics Rules, 1988. The notification was issued vide notification number GSR No. 944 (E) on September 21, 1988. This notification provides a detailed requirement for the conduct of the clinical trial, presentation of trials, import, or manufacture of biotechnological and biological products. Permission is required from the drug

control authorities for the marketing of any new drug manufactured in India or imported to India[55].

Indian legislation system respected hazardous properties of the chemicals and enacted the Chemical Accident Rules, 1996. The definition of hazardous chemicals is the same as the MSIHC Rules, 1989. These rules have created different level crisis groups, Central Crisis Group, State Crisis Group, District Crisis Group and Local Crisis Group to manage the chemical accident. Onsite and offsite plans had to be prepared according to the MSIHC, 1989 only [49].

Prior environmental clearance is necessary before starting a new project according to the Environment Impact Assessment Notification, 2006, unless exempted. Projects are classified as category A and B. The Central Government, the Ministry of Environment and Forests are responsible for category A projects. State Level Environment Impact Assessment Authority (SEIAA) is responsible for the project category B. These authorities give prior environmental clearances on the recommendation of the Expert Appraisal Committee (EAC) at Central Government level and State Expert Appraisal Committee (SEAC) at State level. Information about the project is required in form number I. Form number I, part II, Activity number 8 is, "Risk of accidents during construction or operation of the project, which could affect human health or the environment". Clause number 8.3 specifically asks, "Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudbursts, etc.)?" This shows that this notification recognizes the Natech possibility. Apart from this question, there is no Natech risk management provision and this notification is applicable only for new projects and not for existing technological sites[5].

The Public Liability Insurance Act, 1991 provides for "public liability insurance for immediate relief to affected people by accident involving hazardous substances". This Act is for "hazardous substances" and not only for "hazardous chemicals". The Collector is the Authority for the implementation of the Act. Though speedy financial help is possible under this Act, the relief amount provided is very less[73].

Legislation related to Hazardous Substances and Technological Sites: The oldest legislation dealing with hazardous substances is in the Indian Explosives Act, 1884, which is still in force with necessary amendments. The Indian Explosive Act, 1884 talks about safety, reporting of accidents and licensing system. Authority to execute the Act is with PESO (Petroleum and Explosive Safety Organization) previously known as a CCOE (Chief Controller of Explosives). Now PESO is the Authority for the Petroleum Act, 1934 and the Explosives Act, 1884. The functioning of the organization, procedures they have established and the way they ensure compliance, is exemplary.

Under the umbrella of PESO many other rules like the Static and Mobile Pressure Vessel (unfired) Rules, 2016, The Ammonium Nitrate rules, 2012, The Petroleum Rules. 2016, The Gas Cylinders Rules, 2016, The Calcium Carbide Rules, 1987, The Inflammable Substances Act, 1952 and many others are governed[62]. Ammonium nitrate is an explosive governed under the Indian Explosives Act, 1884[41].

The Gas Cylinder Rules, 2016 apply to all gas cylinders. Gas cylinder means "any closed metal container having a volume exceeding 500 millilitres but not exceeding 1000 litres intended for the storage and transport of compressed gas, including any liquefied petroleum gas (LPG) container or compressed natural gas (CNG) cylinder fitted to a motor vehicle as its fuel tank but not including any other such container fitted to a special transport or undercarriage and includes a composite cylinder and cryogenic container, however, the water capacity of the cylinder used for storage of CNG, nitrogen, compressed air, etc., may exceed 1000 litres up to 3000 litres provided the diameter of such cylinder does not exceed 60 cm". So, except CNG, nitrogen and air, a metal container containing compressed gas will be considered as a gas cylinder up to 1000 litres capacity, beyond which it will be covered by the Static and Mobile Pressure Vessel (unfired) (SMPV) Rules, 2016[60].

Though the process plants and equipment fall under the definition of pressure vessel, they have been specifically exempted from the operation of SMPV Rules. If the pressure of such plants and equipment is more than the atmospheric pressure, they will be considered as a "Pressure Plant" by Section 31 of the Factories Act, 1948.[59,75]

A major boiler explosion that occurred in Calcutta in 1863 caused the loss of several lives. Various provinces then enacted boiler laws, which were inconsistent with each other. So, the Central Government appointed "The Boiler Law Committee" to consolidate and create uniform law for India. As a result, the Indian Boiler Act was enacted in 1923 [78]. The latest definition of the boiler is that - a vessel more than 25 litres capacity used for generating steam by the application of heat and which is at 100^{o}C generating more than one kg per cm^{2} pressure. The boilers used for sanitization in hospitals are excluded up to 100 litres capacity.

Further, the boilers used for locomotives, vessels and belonging to armed forces are excluded from the operation of the Act. The Central Boiler Board has been constituted under Section 27A of the Act to regulate and provide for manufacturing specifications, safety operating procedures and likening etc. Under Section 18, it is necessary to report the accident within 24 hours to the Boiler Inspector. The Indian Boiler Regulation, 1950 deals with the manufacturing part of the boiler. It gives detailed engineering specifications and mandates for sound engineering practices so that the boiler should withstand maximum working pressure. Though this act and regulations made under it are based on

sound engineering and industrial practices, Natech hazard has not been considered in the act or corresponding regulation.[9,45]

The Petroleum Act, 1934 and the Petroleum Rules, 2016 made thereunder are also governed by PESO. According to the Petroleum Act, 1934, petroleum is divided into three classes, "class A flashpoint less than twenty-three degrees centigrade, Class B flashpoint of twenty-three degrees centigrade and above but below sixty-five degrees centigrade and Class C flashpoint of sixty-five degrees centigrade and above but below ninety-three degrees centigrade". All licenses, safety systems, safe distance and electrical safety systems are governed by PESO. The Petroleum Rules, 2016 is a beautiful body of Rules, which clearly defines when a license is required for handling, storing and refining petroleum. It states all safety precautions needed to be taken for the safe handling of petroleum.[69,71]

Many times acts and rules do not specify conditions; instead, it asks to comply with Indian standards, like the Bureau of Indian Standard (BIS) and sometimes with international standards. The Petroleum Rules, 2016 ask for compliance with six Oil Industry Safety Directorate (OISD) Standards. Though OISD standards are only guidelines and not mandatory, these six standards, being accepted by the Petroleum Act, have a mandatory effect. These standards are OISD 105, 116, 117, 118, 141 and 156 about 'Work Permit System', 'Fire Protection Facilities for Petroleum Refineries and Oil/Gas Processing Plants', 'Fire Protection Facilities for Petroleum Depots, Terminals, Pipeline Installations and Lube oil installations', 'Layouts for Oil and Gas Installations', 'Design and Construction requirements for cross country hydrocarbon pipelines' and 'Fire Protection Facilities for Ports Handling Hydrocarbons' respectively.

Though calcium carbide is not petroleum, it generates acetylene gas when it comes in contact with water. Acetylene properties are similar to petroleum, so the Calcium Carbide Rules, 1987 are formed under the Petroleum Act, 1934 to manage and control the hazard of acetylene gas [46].

The Central Government may apply, by notification, any or all provision of the Petroleum Act, 1934 to any and "dangerously inflammable substance" excluding the explosives. The Inflammable Substances Act, 1952 empowers the Central Government to apply the Petroleum Act to seven new "dangerously inflammable substances". Accordingly, acetone, carbide of calcium, a cinematographic film having nitrocellulose base, ethanol, methanol, calcium phosphide and wood naphtha will be considered as petroleum, though they are not petroleum [63]. The Poisons Act, 1919, governs poisons since 1919.

The State Government may by Rules, "regulate, the possession for sale and the sale, whether wholesale or retail, of any specified poison within the whole or any part of the territories under its administration". The Central Government may, by notification in the Official Gazette, regulate the grant of Licenses for any specified poison. The Central Government may prohibit, "the importation of any specified poison into India across any customs frontier defined by the Central Government, except under the conditions of a License"[72].

The Central Motor Vehicles Rules, 1989, deals with the transport of dangerous goods by motor vehicles. United Nations classification number display of Emergency Information Panel is compulsory on all vehicles involving the transportation of hazardous goods. NDMA guidelines for chemical accident prevention also have elaborate provisions for the safety of hazardous goods transport. Apart from other measures, the driver has to undergo three days of defensive driving and chemical safety training for the transportation of dangerous goods[48].

In 1875, the Indian Government appointed the first committee to inquire into the conditions of the factory and create a law to ensure minimum standards. The first Factories Act was adopted in 1881. After independence, many old provisions related to labourers and factories were consolidated in the new Act, the Factories Act, 1948. This new act touched many vital aspects of life safety, disaster management, social security and welfare of the workers working in the factory. Section 12 mandates treatment of every effluent before sending out of the factory. This is a general provision.

Nevertheless, it addresses environmental pollution. This act makes it mandatory for the occupier to prepare an onsite and disaster management plan under Section 41B, but how to prepare the plans has not been explained. Every state has different factory rules formulated under The Factories Act, 1948, for example, the Gujarat Factory Rules, 1963, The Karnataka Factory Rules, 1969, etc. The Maharashtra Factories Rules, 1963 governs safety and welfare provisions in the factories in minute details as per the guiding principle is given in the Factories Act, 1948. Only implied Natech related provision under Rule 70(3) of the Maharashtra factories Rules, 1963 is, "protection against lightning" [59,65].

The Electricity Act, 2003, requires the Union Government to prepare a Tariff Policy and National Electricity Policy in consultation with the Central Electricity Authority of India (CEA) and the State Governments. The primary purpose of the Act is the development of the power system based on the optimal utilization of resources. The Central Electricity Authority has been created under the Act (created under Section 3(1) of the repealed Electricity (Supply) Act, 1948). This authority prepares the National Plan. National, Regional and State load dispatch centres have been created for optimum scheduling and dispatch of electricity. Central, State and Joint regulatory commissions have been established to regulate tariff and other matters[56].

The Electricity Act has created nationwide infrastructure, but detailed safety precautions regarding electricity are elaborated in the Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2010. Only implied Natech related provision is found under regulation 74, "protection against lightning"[47].

In India, atomic energy is being governed by the Department of Atomic Energy (DAE) reporting directly to the Prime Minister. Under the Atomic Energy Act, 1962, Central Government has got power, "to produce, develop, use and dispose of atomic energy either by itself or through any authority or Corporation". The Central Government under this Act can control or acquire any mining plant dealing with fissile material. The Authority for enforcement of the provisions lies with the Central Government. These authorities also include the appointment of inspecting staff and the making of rules under the Indian Mines Act, 1952 and the Factories Act, 1948. Accordingly, the mines having radioactive substances are governed by the Atomic Energy (Working of the mines, minerals and handling of prescribed substances) Rules, 1984.

The factories involving radioactive substances are governed by Atomic Energy (Factories) Rules, 1996. General radiation safety is handled by the Atomic Energy (Radiation Protection) Rules, 2004 made under the Atomic Energy Act, 1962. The Civil Liability for Nuclear Damage Act, 2010 and the Civil Liability for Nuclear Damage Rules, 2011 provide for elaborate provisions regarding civil liability arising from any accident involving radioactivity. This way, all fissile and radioactive material is directly brought under the control of the Central Government [42,43,50,51].

Legislations related to Disaster Management: India has a quasi-federal governing system. Though more powers are centralized at the Union level, many subjects lie within the control of State Governments. The Seventh Schedule to the Constitution of India ensures distribution of powers and function between Union Government and State Government by creating three separate lists, Union List, State List and Concurrent List.

The Concurrent list contains powers and functions common to both Union and State Government. The subject of disaster risk reduction was not listed specifically in any list of the seventh schedule. Primarily it was the responsibility of the respective State Government with the assistance of the Central Government[32].

However, the need was felt to bring a paradigm shift in disaster management. Ministry of Agriculture and the National Disaster Response committee together constituted a "High Power Committee" under the chairmanship of Mr J.C Pant in August 1999. The primary purpose of the committee was "to suggest measures to bring about institutional reforms in the field of disaster management". Disaster Management Act was one of the recommendations of the Pant Committee[74]. With this background, the awaited Act was passed in 2005, named as Disaster Management Act, 2005.

A paradigm shift had been envisaged in the approach from reactive relief based approach to a proactive, holistic approach towards preparedness, prevention, mitigation, speedy response and build back. This Act has created a system in the country including provisions for National Disaster Management Plan, State Level Disaster Management Plan, District Level Disaster Management Plan, Government Ministries and Department level Disaster Management Plan under the common umbrella of the NDMA (National Disaster Management Authority). The Prime Minister is the chairperson of NDMA. National Executive Committee (NEC) comprised of secretaries of Different Ministries and Chief of Integrated Defense Staff.

The National Disaster Response Force (NDRF) has been created consisting of paramilitary forces equipped with special training and equipment for response and rescue phases. They established a National Disaster Mitigation Fund and National Disaster Response Fund for the financial backup plan. For every district, a District Emergency Authority (DEA) has been created. The responsibility to create a detailed disaster management plan lies with this Authority, generally headed by District Collector. The responsibilities have been fixed and resources have been identified for disaster management[54].

NDMA guidelines on chemical accidents recognize that natural forces can cause a chemical disaster. The executive summary mentions that "common causes for chemical accidents are deficiencies in safety management systems and human errors, or they may occur as a consequence of natural calamities or sabotage activities". Clause 1.3.2 "Natural Calamities" recognizes that "the Indian subcontinent is highly prone to natural disasters, which can also trigger chemical disasters". As an example, guidelines give two cases, "damage to phosphoric acid sludge containment during the Orissa super cyclone in 1999 and the release of acrylonitrile at Kandla Port, during an earthquake in 2001". Under clause 5.2 storage v (g) guidelines suggest the usage of, "lightning arrestors for storage of gases such as hydrogen that can make an explosive mixture with air".

Further, annexure F of the guideline requires that the onsite emergency plan should have "emergency response procedures for Hurricane" for coastal areas. The guidelines have a passing mention of natural hazards compounding with technological hazards, but apart from that, these guidelines have not given detailed attention to Natech risk management. [29]. The recent legislation, "Petroleum and Natural Gas Regulatory Board, Emergency Response and Disaster Management Plan Regulations (ERDMP), 2010" enacted by PNGRB is a comprehensive effort towards disaster risk reduction. These regulations are of greater importance from a vantage point of disaster management.

Some of the key features are as follows:

i. These regulations apply to installations involving hydrocarbons only and not for any other hazardous chemicals.
ii. These regulations are currently applicable to only the petroleum industry under the Ministry of Petroleum and Natural gas.
iii. ERDMP regulations are location-specific; for different areas according to natural, geological, climatic and social settings, different plans will be prepared.
iv. ERDMP mandates to take account of NDMA chemical guidelines while preparing a disaster management plan, indirectly making NDMA chemical guidelines mandatory.
v. Not only the cascading effect of the technological accident is considered, but offsite emergencies initiating onsite emergencies have also been considered.
vi. All installations having ERDMP have to provide help to civil authorities. Any contradiction to this provision attracts a heavy penalty.
vii. Identified causes for an accident include among others natural calamities also.
viii. The uniform siren code system throughout the country.

It has been realized that apart from mere recognition, no specific provision for Natech risk management can be seen in the legislation[70].

Conclusion

The general approach of accident prevention legislation in India is that the legislation identifies specific risk areas, creates rules for the safety of human and environment. Legislation assigns the responsibility of safe handling of hazardous materials on the person, "who has ultimate control over the affairs" of the technological site, called an "occupier". Respective executive authorities enforce the legislation. Safe and accident-free operation is the responsibility of the occupier and accident reporting is mandatory. Penalties are provided for the contravention of any provision of the legislation.

India has an excellent legal framework for governing hazardous substances. The country has identified and explicitly defined various hazardous substances in different categories. The Government has also identified Major Accident Hazard Installations and specific laws for the safety of the technological sites are already in place.

The Disaster Management Act, 2005 and The Environment Protection Act, 1986 are two important legal frameworks for the management of disasters in India. These two legislations along with ERDMP regulation, 2010, have created a world-class legal framework for effective and efficient management of any kind of disaster as other developed countries. Despite all these efforts, specific provisions for Natech risk management are found to be missing. Lightning as a natural hazard has been recognized conspicuously. New legislation like ERDMP specifically acknowledges natural forces as a cause of the disaster. The NDMA chemical guidelines use the word Natech only once and consider it as a rare phenomenon. Earlier the Natech might have been a rare event, but with growing dependence on technology and climate change, Natech is no longer a rare phenomenon.

Therefore, there is a need to ensure that the existing legal framework of the safety management system is further improved and made effective and efficient. There is a need to create specific legislation to identify and reduce Natech risk for accidents involving hazardous substances. The focus should not only be on technological sites handling hazardous chemicals but on other hazardous technologies such as radioactive substances and hazardous micro-organisms. As a developing and densely populated country, India cannot afford any kind of risk to its infrastructure. Under these circumstances, it becomes necessary for India to consider and manage Natech risk proactively by creating specific legislation.

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