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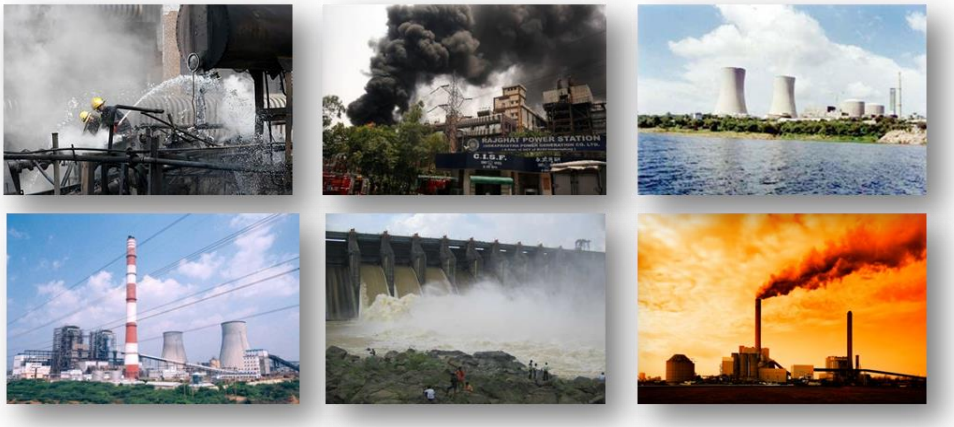
DISASTER MANAGEMENT PLAN FOR POWER SECTOR



विद्युत मंत्रालय
भारत सरकार
नई दिल्ली
दिसंबर, 2022

MINISTRY OF POWER
GOVERNMENT OF INDIA
NEW DELHI
December, 2022

(Prepared by Central Electricity Authority in fulfilment of provisions of Disaster Management Act 2005)

(आपदा प्रबंधन अधिनियम 2005 के प्रावधानों की पूर्ति में केंद्रीय विद्युत प्राधिकरण द्वारा तैयार)

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Abbreviations

ACSR	:	Aluminum Conductor Steel Reinforced
AGD	:	Agricultural Department
AHD	:	Animal Husbandry Department
AICTE	:	All India Council for Technical Education
ANM	:	Auxiliary Nurse Midwife
APTEL	:	Appellate Tribunal for Electricity
ASHA	:	Accredited Social Health Activist
ATI	:	Administrative Training Institute
AYUSH	:	Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
BBMB	:	Bhakra Beas Management Board
BECCS	:	Bio-energy with Carbon Capture and Storage
BEE	:	Bureau of Energy Efficiency
BIS	:	Bureau of Indian Standards
BPHE	:	Biological and Public Health Emergencies
BRO	:	Border Roads Organization
CAPF	:	Central Armed Police Forces
CBRI	:	Central Building Research Institute, Roorkee
CBRN	:	Chemical, Biological, Radiological, and Nuclear
CBSE	:	Central Board of Secondary Education
CCA	:	Climate Change Adaptation
CCS	:	Carbon Capture and Storage
CDEF	:	Civil Defence
CDMG	:	Central Level Disaster Management Group
CDMM	:	Centre for Disaster Mitigation and Management, Vellore
CEA	:	Central Electricity Authority
CERC	:	Central Electricity Regulatory Commission
COR	:	Commissioner of Relief
CPRI	:	Central Power Research Institute
CPSU	:	Central Public Sector Undertaking
CRIDA	:	Central Research Institute for Dryland Agriculture
CSIR	:	Council of Scientific and Industrial Research
CTU	:	Central Transmission Utility
CVT	:	Capacitor Voltage Transformer
CWC	:	Central Water Commission
DDMA	:	District Disaster Management Authority
DFIN	:	Finance Department
DISCOM	:	Distribution Company
DM	:	Disaster Management
DMD	:	Disaster Management Department
DOS	:	Department of Science
DOT	:	Department of Telecommunications
DSJE	:	Department of Social Justice & Empowerment
EDD	:	Education Department
EFD	:	Forest & Environment Department
EMC	:	Emergency Medical Care
EMG	:	Emergency Management Group
EMRS	:	Emergency Medical Response System

EOC	:	Emergency Operation Center
EREC	:	Earthquake Risk Evaluation Centre
ERS	:	Emergency Restoration Systems
F&ES	:	Fire and Emergency Services
FIHD	:	Fisheries (relevant) Department
GACC	:	Global Agreement on Climate Change
G&D	:	Gauge & Discharge
GENCO	:	Generation Company
GIL	:	Gas Insulated Lines
GoI	:	Government of India
GSI	:	Geological Survey of India
HAP	:	Heat (Wave) Action Plan
HEOC	:	Health Emergency Operation Center
HFWD	:	Health & Family Welfare Department
HRVA	:	Hazard Risk & Vulnerability Analysis
HTLS	:	High Temperature Low Sag
HVDC	:	High Voltage Direct Current
IAF	:	Indian Air Force
ICAR	:	Indian Council of Agricultural Research
ICG	:	Indian Coast Guard
ICU	:	Intensive Care Units
IDSP	:	Integrated Disease Surveillance Programme
IEC	:	Information Education Communication
IIE	:	Indian Institute of Entrepreneurship
IIT	:	Indian Institute of Technology
IHR	:	Indian Himalayan Region
IMD	:	India Meteorological Department
INCOIS	:	Indian National Centre for Ocean Information Services
IPCC	:	Intergovernmental Panel on Climate Change
IPRD	:	Information and Public Relations Department
IRD	:	Irrigation Department
ISG	:	Ocean Information and Forecast Services Group
QRMT	:	Quick Reaction Medical Teams
LA	:	Lightning Arrester
LBSNA	:	Lal Bahadur Shastri National Academy of Administration
LDC	:	Load Despatch Centre
LHZ	:	Landslide Hazard Zonation
MAFW	:	Ministry of Agriculture & Family Welfare
MANAGE	:	National Institute of Agricultural Extension Management
MCI	:	Ministry of Commerce and Industry
MCOM	:	Ministry of Communications
MEA	:	Ministry of External Affairs
MEITY	:	Ministry of Electronics & Information Technology
MFIN	:	Ministry of Finance
MFR	:	Medical First Responders
MHFW	:	Ministry of Health & Family Welfare
MHUA	:	Ministry of Urban Development
MLBE	:	Ministry of Labour and Department
MNCFC	:	Mahalanobis National Crop Forecast Centre
MoCA	:	Ministry of Civil Aviation
MoCIT	:	Ministry of Communication & Information Technology

MoD	:	Ministry of Defence
MoEFCC	:	Ministry of Environment, Forest and Climate Change
MoES	:	Ministry of Earth Science
MoIB	:	Ministry of Information and Broadcasting
MoJS	:	Ministry of Jal Shakti
MoM	:	Ministry of Mines
MoNRE	:	Ministry of New & Renewable Energy
MoP	:	Ministry of Power
MoPNG	:	Ministry of Petroleum & Natural Gas
MoPR	:	Ministry of Panchayati Raj
MoR	:	Ministry of Railway
MoRD	:	Ministry of Rural Development
MoSPI	:	Ministry of Statistics and Programme Implementation
MoST	:	Ministry of Science and Technology
MoYAS	:	Ministry of Youth Affairs and Sports
MPRJ	:	Ministry of Panchayati Raj
MSDE	:	Ministry of Skill Development and Entrepreneurship
MSJE	:	Ministry of Social Justice and Empowerment
NCDC	:	National Center for Disease Control
NCMC	:	National Crisis Management Committee
NDMA	:	National Disaster Management Authority
NDRF	:	National Disaster Response Fund
NEC	:	National Executive Committee
NHPC Ltd.	:	National Hydroelectric Power Corporation Limited
NIC	:	National Informatics Centre
NICRA	:	National Initiative on Climate Resilient Agriculture
NIDM	:	National Institute of Disaster Management
NIESBUD	:	National Institute for Entrepreneurship and Small Business Development
NIMSME	:	National Institute for Micro, Small and Medium Enterprises
NIRM	:	National Institute of Rock Mechanics
NISA	:	National Institute of Security Academy
NLDC	:	National Load Despatch Centre
NLRTI	:	National Level Research & Technical Institutions
NLSDA	:	National Level Skill Development Agencies
NMSA	:	National Mission on Sustainable Agriculture
NPTI	:	National Power Training Institute
NRAA	:	National Rainfed Area Authority
NSDA	:	National Skill Development Agency
NSDC	:	National Skill Development Corporation
NTPC	:	National Thermal Power Corporation
O&M	:	Operation & Maintenance
PED	:	Power Energy Department
PGCIL	:	Power Grid Corporation of India Limited
Grid – India	:	Grid Controller of India Limited
PPE	:	Personal Protective Equipment
PRI	:	Panchayati Raj Institutions (District, Block & Village level)
PWD	:	Public Works Department
RD	:	Rural Development
RDD	:	Radiological Dispersal Device
RDMG	:	Regional Level Disaster Management Group

RLDC	:	Regional Load Despatch Centre
RMU	:	Ring Main Unit
RPC	:	Regional Power Committee
SASE	:	Snow and Avalanche Study Establishment
SAU	:	State Agricultural University
SDMA	:	State Disaster Management Authority
SDMG	:	State Level Disaster Management Group
SDRF	:	State Disaster Response Fund
SEOC	:	State Emergency Operation Centre
SERC	:	State Electricity Regulatory Commission
SIDM	:	State Institute of Disaster Management
SIRD	:	State Institute for Rural Development
SJVN Ltd.	:	Satluj Jal Vidyut Nigam Limited
SLDC	:	State Load Despatch Centre
SLRTI	:	State Level Research & Technical Institutes
SLSDA	:	State Level Skill Development Agencies
SPWD	:	State Public Water Department
SRASC	:	State Remote Sensing Centres
SSC	:	Structures, Systems, or Components
STU	:	State Transmission Utility
ToT	:	Training of Trainers
TRANSCO	:	Transmission Company
UDD	:	Urban Development Department
UGC	:	University Grants Commission
ULB	:	Urban Local Bodies (municipal corporations, municipalities, nagarpalikas)
UN	:	United Nations
UNDRR	:	United Nations Office for Disaster Risk Reduction
WIHG	:	Wadia Institute of Himalayan Geology
WRD	:	Water Resources Department

EXECUTIVE SUMMARY

Background

Power Sector is one of the most important infrastructures of the country, as growth of this sector is directly correlated with the economic growth of the country. Any disruption in the power sector due to disaster creates hardship to human beings, as every aspect of human life is directly or indirectly associated with electricity.

India has experienced many disasters such as floods, earthquakes, tsunamis and cyclones in the past. Disasters always involve loss/damage to the infrastructure of the country. In order to eliminate or if not possible, to minimize damage/disruption in generation, transmission and distribution of electricity, it becomes extremely important to prepare a disaster management plan for this sector and to keep on improving it with the emerging best practices and knowledge base.

The very purpose of preparation of this document is to evolve a more proactive, holistic and integrated approach of strengthening disaster mitigation, preparedness, emergency response and recovery in the event of any disaster taking place. The "Disaster Management Plan for Power Sector" provides a framework and direction to the utilities in the power sector for all phases of the disaster management cycle (i.e. Mitigation, Preparedness, Response and Recovery). It is intended to guide all agencies within the sector with a general concept of potential emergencies and roles and assignments before, during, and following emergency situations.

The plan covers the subjects of Institutional Framework for Disaster Management, Hazard Risk and Vulnerability Analysis (HRVA), Coherence of Disaster Risk Management across Resilient Development and Climate Change Action, Mainstreaming Disaster Risk Reduction, Disaster Risk Reduction and Building resilience, Preparedness & Response, Recovery and Reconstruction, Capacity Building & Financial Arrangements in separate chapters. However, a few elements of some of these subjects are present implicitly or explicitly in every chapter. This document is in accordance with the provisions of the Disaster Management Act 2005 and the guidelines issued by National Disaster Management Authority (NDMA) from time to time and aligned with National Disaster Management Plan 2019. It is also consistent with the three landmark global agreements reached in 2015 – (i) Sendai Framework for Disaster Risk Reduction, (ii) Sustainable Development Goals of United Nations and (iii) Climate Change Agreement (COP21) that together represent a nearly complete agenda for building disaster resilience. It also aims at achieving the contemporary national priorities set within Prime Minister's Ten Point Agenda for Disaster Risk Reduction (DRR).

Vision

To make Indian power sector disaster-resilient, achieve substantial disaster risk reduction, and significantly decrease the loss by maximizing the ability to cope with disasters at all levels of administration as well as at the field level.

Institutional Arrangements for Disaster Management in Power Sector

The overall coordination of disaster management vests with the Ministry of Home Affairs (MHA). The Cabinet Committee on Security (CCS) and the National Crisis Management Committee (NCMC) are the key committees involved in top-level decision-making with regard to disaster management. NDMA is the lead agency responsible for the preparation of DM plans and the execution of DM functions at the national level. In most cases, state governments carry out disaster management with the central government playing a supporting role. The central agencies participate only on the request from the state government.

In the context of power sector specifically, it is envisaged to place a four-tier structure at Central, Regional, State and Local Unit Levels viz. Central Level Disaster Management Group (CDMG), Regional Level Disaster Management Group (RDMG), State level Disaster Management Group (SDMG) and Local Level Emergency Management Group (EMG) with intervention and response depending on the severity of the disaster /calamity. Ministry of Power has designated National Load Despatch Centre (NLDC) as Central Control room to deal with disasters in the power sector.

Hazard Risk & Vulnerability Analysis (HRVA)

Hazard Risk & Vulnerability Analysis involves vulnerability mapping, zoning for natural disasters such as wind, cyclones, earthquakes, tsunamis, floods etc. and it is the basic building block on which the plans for disaster risk reduction are made. Aim of such analysis is to evolve methods for finding quantitative risk involved in power sector to devise effective strategies for prevention, mitigation, response, and recovery. This will be helpful for policy and decision-makers to evaluate strategies and measures for infrastructure planning and protection such as framing construction and safety norms for the power establishment according to the hazard zone.

Coherence of Disaster Risk Management across Resilient Development and Climate Change Action

The adoption of three landmark global agreements - Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals (SDGs) and COP21 Paris Agreement on Climate Change in 2015 has opened significant opportunities to

build coherence across DRR, sustainable development and response to climate change. Given the complementarities among them, synchronising and mutually reinforcing the actions in the three domains helps in better outcomes. Efforts must be made to ensure that each of them does not build in "policy risks" or, contradictory policies, that generate more - rather than less - risk in development. Promoting coherence and mutual reinforcement in all three agreements requires political recognition, monitoring, reporting and supporting partnerships at various levels. The plan has attempted to address the challenges of providing coherence and mutual reinforcing of the national initiatives corresponding to the three post-2015 global frameworks embracing the domains of DRR, sustainable development and responses to meet challenges of global climate change.

Mainstreaming Disaster Risk Reduction

Disasters have an enormous adverse impact on development. Not only it sets back development process and suddenly reverses decades or more of accumulated developmental gains by damaging the key establishments instrumental for development, but the resources that are planned for further development are often diverted for the recovery process. The impact can be minimised or reduced significantly if adequate risk reduction measures had been incorporated into the development. Also, the development process itself creates disaster risks if not implemented appropriately and disaster risk reduction considerations have not been taken into account in designing the development activities. It warrants that the development activity and disaster risk reduction should be dealt with in unison with all the relevant policies, planning and implementation. Such an approach, which internalises DRR within development in a closely integrated manner is called mainstreaming Disaster Risk Management (DRM). It means radically expanding and enhancing DRM so that it becomes normal practice, fully institutionalised within each agency's regular planning and programmes in addition to the preparedness for disaster response. Disaster risk reduction can be mainstreamed into development frameworks in various ways and at different levels - spanning the legislative, institutional, sectoral strategies and financial planning. The plan emphasis on mainstreaming Disaster Risk Reduction into all developmental plans of power sector and suggests for making it an integral part of the project assessment process.

Disaster Risk Reduction and Building Resilience

India was, earlier a reactive nation and had responded only to disasters and provided relief from calamity. However, in recent times, there has been a paradigm shift and India has become proactive with emphasis on disaster prevention, mitigation and preparedness. In today's scenario, disaster management is a continuous and integrated process of planning, organizing, coordinating, and

implementing measures, which are necessary for prevention of danger or threat of any disaster.

The approach used in this plan suggests six thematic areas for action for each hazard viz. Understanding Risk, Inter-Agency Coordination, Investing in DRR – Structural Measures, Investing in DRR – Non-Structural Measures & Capacity Development in accordance with four priorities set under Sendai framework. The activities are envisaged under short/ immediate (within 5 years), medium (within 10 years), and long-term (within 15 years) categories, which will be implemented in many instances concurrently, and not necessarily sequentially.

Preparedness and Response

Preparedness covers activities and measures taken in advance to ensure an effective response to the impact of hazards, including issuance of timely and effective early warnings and temporary evacuation of people and property from the threatened location. It aims at building the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery. On the other hand, Response measures are those taken immediately after receiving an early warning from the relevant authority or in anticipation of an impending disaster, or immediately after the occurrence of an event without any warning. The primary goal of response to a disaster is saving lives, protecting property, environment, and meeting the basic needs of humans and other living beings after the disaster.

Preparedness and response consist of different aspects, which are to be covered as an organisational practice for effective management in the event of the occurrence of any disaster. The plan provides a framework for effective and well-organised coordination among different organisations like RPC, NLDC, RLDC, SLDC, STU, CTU for managing things in better ways in the situation of disaster. This includes aspects like measures for quick restoration of power supply, restoration of transmission/distribution line, use of Emergency Restoration Systems (ERS), restoration of Sub-Stations, restoration of load despatch centres (LDCs), Media Management etc.

Recovery and Reconstruction

The recovery stage covers immediate restoration to long-term betterment reconstruction. It tends to be a difficult and long-drawn-out process. Broadly six stages are involved in the recovery process - Post-Disaster Needs Assessment and Credible Damage Assessment, Developing a vision for Build-Back Better (BBB), Ensuring coherence of BBB with the development programs and goals, Incorporating resilience and BBB in recovery vision, Balancing recovery across sectors & Prioritising sectors for recovery.

The recovery task begins soon after the emergency phase ends, and it should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action. The focus of recovery is on restoring livelihoods and shifting to a path of sustainable development that reduces disaster risk. The plan for recovery should be designed keeping in view the worst-case scenarios.

Globally, the approach towards post-disaster restoration and rehabilitation has shifted to one of betterment reconstruction. While disasters result in considerable disruption of normal life, enormous suffering, loss of lives and property, global efforts consider the recovery, rehabilitation and reconstruction phase as an opportunity to "Build Back Better" (BBB) integrating disaster risk reduction into development measures and making communities resilient to disasters. The plan also emphasises this aspect and recommends for the strengthening of infrastructure in the recovery process based on the learning gained.

Capacity Building

Investing in capacity development for DRR is a continuing process of enhancing the capability of individuals, agencies, and communities to improve the performance of their DM functions. It is a cost-effective way to save lives, prevent or reduce losses and ensure effective recovery and rehabilitation.

Capacity building in power sector involves areas like prevention or mitigation for disaster risk reduction, effective preparedness and response, recovery and building back better infrastructure. This covers programmes in Building Resilience in Electricity infrastructure, Mock Drill Exercises, Public Awareness Programmes, Risk assessment and Vulnerability study in each area of responsibility etc.

Financial Arrangements

The primary responsibility for undertaking rescue, relief, and rehabilitation measures during a disaster lies with the State Governments and the Central Government supplements their efforts through logistic and financial support. Under the DM Act, 2005, a financial mechanism has also been set up by way of National Disaster Response Fund (NDRF) at the national level and State Disaster Response Fund (SDRF) at the state level to meet the rescue and relief expenditure during any notified disaster. Under the notified norms, relief for repairing the damaged power sector infrastructure of immediate nature is provided through NDRF/SDRF funds. Apart from that, for the power sector exclusively, the plan recommends for creation of a fund of 1.5% of annual revenue by each power utility for meeting the expenditure of disaster management requirement.

Chapter-1

1. Introduction

1.1 Profile of the Ministry of Power

Ministry of Power, Government of India, is primarily responsible for the development of the electricity sector in the country. The Ministry is concerned with perspective planning, policy formulation, processing of projects for investment decision, monitoring of implementation of power projects, training and manpower development and administration and enactment of legislation in regard to thermal and hydropower generation, transmission and distribution of electricity etc. Ministry of Power is responsible for the Administration of Electricity Act, 2003, Energy Conservation Act, 2001 and to undertake such amendments to these Acts, as may be necessary from time to time, in conformity with the Government's policy objectives.

Ministry of power has a vital role in disaster management in the power sector. It coordinates disaster management at the central level with national agencies like NDMA and other central ministries of Govt. of India.

1.2 Rationale

UNDRR considers disaster to be a result of the combination of many factors such as exposure to hazards, conditions of vulnerability that are present, and insufficient capacity or measures to reduce or cope with the potential negative consequences. The revised UNDRR terminology defines 'disaster' as:

> *"A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts."* (UNDRR 2016)

DM Act 2005 defines "Disaster" as –

> *"Disaster" means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."*

Disaster impacts include loss of life, injuries, disease and other negative effects on human physical, mental and social well-being, together with damage to property,

destruction of assets, loss of services, social and economic disruption and environmental degradation.

Any disaster can lead to disruption in generation, transmission, power system operation, distribution and supply of electricity. Electricity is the lifeline of the economy as well as of society and any disruption in electricity supply not only causes loss to the economy, but it also creates hardship to human beings, as every aspect of human life is connected to electricity. It, therefore, becomes extremely important to evolve a disaster management plan to reduce the disaster risks and restore the generation, transmission, distribution and supply of electricity to affected areas in the shortest possible time with minimum damage to infrastructure.

According to the revised UNDRR terminology, Disaster Management (DM) is "*the organization, planning and application of measures preparing for, responding to and recovering from disasters*" and Disaster Risk Management (DRM) is "*the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses*" (UNDRR 2016). The sense in which DM Act 2005 uses the term disaster management, covers nearly both DM and DRM without maintaining a strict distinction between the two. It defines Disaster Management as:

> *"A continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient" for the following: 1) Prevention of danger or threat of any disaster, 2) Mitigation or reduction of risk of any disaster or its severity or consequences, 3) Capacity-building, 4) Preparedness to deal with any disaster, 5) Prompt response to any threatening disaster situation or disaster, 6) Assessing the severity or magnitude of effects of any disaster 7) Evacuation, rescue and relief, and 8) Rehabilitation and reconstruction.*

The term Disaster Management as used in the DM Act 2005 (and also in NPDM 2009) is comprehensive covering all aspects – disaster risk reduction, disaster risk management, disaster preparedness, disaster response, and post-disaster recovery and covers nearly both DM and DRM definitions given by UNDRR without maintaining a strict distinction between the two. This document uses the term "Disaster Management" with the same meaning as defined above and deals with the various events, which may cause disasters in the power sector, suggests preventive measures which need to be adopted to avoid any disaster and also the ways and means to tackle a disaster if it occurs in spite of preventive measures. It outlines a hierarchical set up of disaster management at various levels for effectively and efficiently dealing with emergent situations as well as roles/responsibilities of

various Central/State Departments and utilities in disaster management as per provisions of DM Act 2005 and NPDM 2009.

India was until recently, reactive and only responded to disasters and provided relief from calamity. It was a relief driven disaster management system. In recent times, there has been a paradigm shift and India has become or is becoming more proactive with emphasis on disaster prevention, mitigation and preparedness. The approach now emphasises on all four stages of disaster management cycle – Mitigation, Preparedness, Response and Recovery covering pre, peri and post strategies for a disaster.

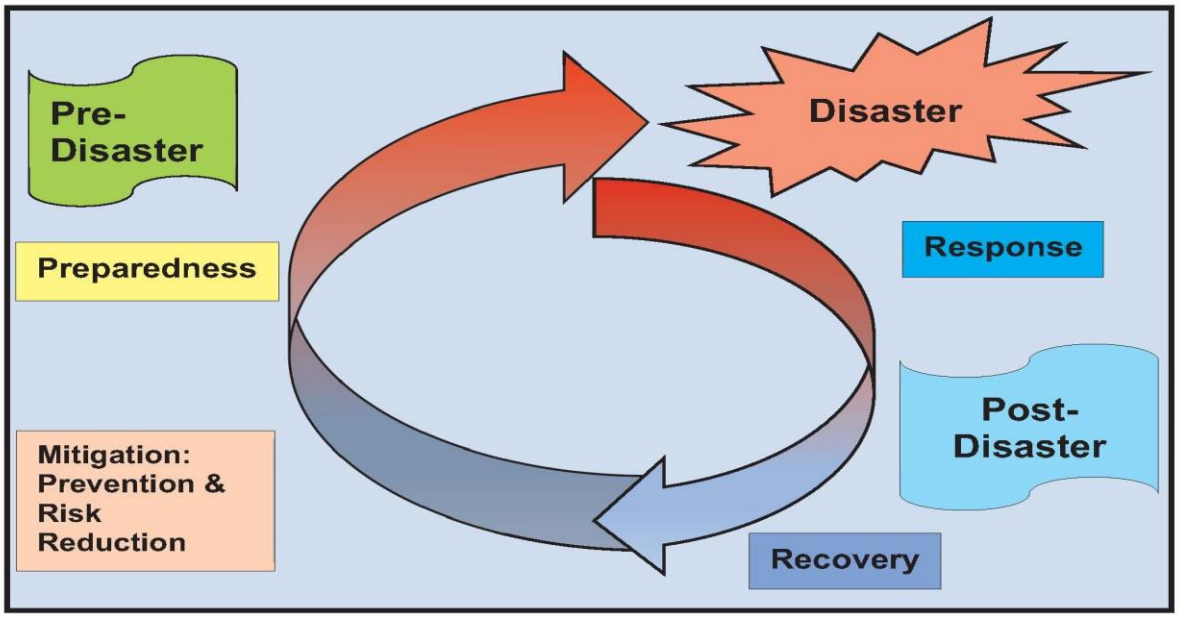

Figure-1.1: Disaster Management Cycle

Mitigation (Prevention & Risk Reduction)

Mitigation consists of a framework of elements that will help to minimize vulnerabilities and disaster risks throughout the societies and to avoid or to limit adverse impacts of hazards. It covers means to check possible turning up of a hazard into a disaster such as avoiding construction in seismically active areas or designing/building the infrastructure to bear the disaster.

Preparedness

The UNDRR defines preparedness as "*the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions*". It covers activities and measures taken in advance to ensure an effective response to the impact of hazards, including the issuance of timely and effective early warnings and temporary evacuation of people and property from the threatened location.

For an effective response, all the stakeholders need to have a clear vision about hazards, their consequences, clarity on plans of action and must be well versed with their roles and responsibilities.

Response

The UNDRR defines response as "*Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basis subsistence needs of the people affected*".

Response measures are those taken immediately after receiving an early warning from the relevant authority or in anticipation of an impending disaster, or immediately after the occurrence of an event without any warning. These activities are immediately initiated by the community itself and then by the district, state, national or up to international levels. The response includes not only those activities that directly address the immediate needs, such as a warning to vulnerable populations, evacuation to avoid further damages, search and rescue, restoration of key infrastructure etc. but also rapid mobilization of various systems necessary to coordinate and support the efforts.

The primary goal of response to a disaster is saving lives, protecting property, environment, and meeting the basic needs of humans and other living beings after the disaster. Its focus is on rescuing those affected and those likely to be affected by the disaster.

Recovery

UNDRR defines recovery as *"The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and build back better, to avoid or reduce future disaster risk."*. It covers immediate restoration to long-term betterment reconstruction.

There are three recovery periods after a disaster: a) Early – three to eighteen months, b) Medium – within five years and c) Long-term – within five to ten years. The recovery phase can be considered as an opportunity to "build back better" thereby integrating disaster risk reduction into development measures, and making communities resilient to disasters.

1.3 Legal Mandate

As per Section 37 of the Disaster Management Act, every Ministry or Department of the Government of India shall prepare a disaster management plan specifying the following particulars:

i. The measures to be taken by it for prevention and mitigation of disasters in accordance with the National Plan.

ii. The specifications regarding integration of mitigation measures in its developmental plans in accordance with the guidelines of the National Authority and the National Executive Committee.

iii. Its role and responsibilities in relation to preparedness and capacity building to deal with any threatening disaster situation or disaster.

iv. Its roles and responsibilities in regard to promptly and effectively responding to any threatening disaster situation or disaster.

v. The present status of its preparedness to perform the roles and responsibilities specified in sub-clauses (iii) and (iv).

vi. The measures required to be taken in order to enable it to perform its responsibilities specified in sub-clause (iii) and (iv).

This plan is in conformation with these provisions of the DM Act.

1.4 Vision

To make Indian power sector disaster-resilient, achieve substantial disaster risk reduction, and significantly decrease the loss by maximizing the ability to cope with disasters at all levels of administration as well as at the field level.

1.5 Scope

The Disaster Management Plan for the Power Sector is intended to guide all agencies within the sector with a general concept of potential emergencies and roles and assignments before, during, and following emergency situations. It covers the roles/responsibilities of various concerned in line with the principles laid down by the DM Act, 2005. It encompasses the activities that enable various agencies involved in generation, transmission, distribution and supply of electricity to plan for, quickly respond to and to recover from unexpected events and situations. It provides necessary guidelines for assistance to these organizations for ensuring safety of people, protection of installation and environment and restoration of power supply.

Apart from this document, sector-specific generic documents on disaster management for thermal & hydro generation, transmission, distribution and renewable energy sectors are also separately brought out by CEA. These disaster management plans provide broad guidelines to the utilities to prepare the documents for disaster management encompassing the emergency situations to which their establishments are vulnerable.

The administrative response to disasters is by and large the responsibility of the State Government and intervention of the Central Government is sought in the case of disasters of large proportions. However, as disaster management is a multi-disciplinary process, all Central Ministries and Departments have key roles in the field of Disaster Management & the plan provides a framework for inter-agencies coordination also.

1.6 Objectives

The plan has the following objectives:

a) To improve state of preparedness to meet any contingency.
b) To reduce response time in organizing the assistance.
c) To identify major resources, manpower, material and equipment needed to make the plan operational.
d) Making optimum use of the combined resources.

1.7 Time Frames – Short, Medium and Long-Term

The year 2030 is the end of time frame for all three post-2015 international agreements – Sendai Framework, SDG and the COP21 and by being a signatory to these agreements, India has also adopted this timeframe. The measures identified in the plan requires to be implemented within the short (T1), medium (T2), and long-term (T3), ending by 2022, 2027, 2030 respectively.

The reference to 'Short', 'Medium and 'Long' are to timeframes required for completion and do not signify an order of priority. These are tentative and subject to changes depending on many factors, particularly technology. Some of the actions envisaged could be shifting from a longer time frame to a shorter one. However, all-out efforts are needed to ensure that those under smaller time frames are not taking additional time for completion.

Box-1.1: Time Frame

- The measures identified in the plan requires to be implemented within the short (T1), medium (T2), and long-term (T3), ending by 2022, 2027, 2030 respectively.
- In the case of recovery, there are three recovery periods after a disaster: a) Early – within eighteen months, b) Medium – within five years and c) Long-term – within five to ten years.

While some of the suggested measures in all categories – short, medium, and long-term – are already under implementation or in need of upgrading, many need to be initiated. The timeframes short, medium and long do not mean that the three are necessarily sequential in all cases. In fact, in many cases, they may be overlapping, starting at the same time while in some cases, the work on the medium and long-

term targets may be dependent on the completion of the previous phase. Nevertheless, the medium and long-term categories do not imply a lower priority but are actions that require time long period for completion provided they are started as early as possible.

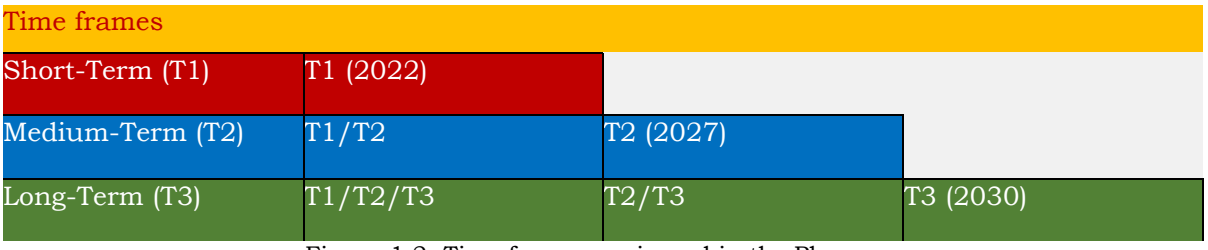

Figure-1.2**:** Time frames envisaged in the Plan

In the case of recovery, there are three recovery periods after a disaster: a) Early – within eighteen months, b) Medium – within five years and c) Long-term – within five to ten years. These depend on the specific disaster and are relevant only with reference to the types of recovery programmes. Hence, the plan discusses them only in general terms without timelines.

1.8 Compliance, Conformity and alignment with NDMP & Global Frameworks

This document is in accordance with the provisions of the DM Act 2005 and guidelines issued by NDMA from time to time and the established practices. It is also aligned with National Disaster Management plan 2019 that is consistent with Sendai Framework for Disaster Risk Reduction 2015-30 that identifies four priorities for action – (i) Understanding disaster risk, (ii) Strengthening disaster risk governance to manage disaster risk, (iii) Investing in disaster risk reduction for resilience & (iv) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction. The plan includes measures that will be implemented over the short, medium, and long-term more or less over the time horizon of the Sendai Framework ending in 2030.

For each hazard, approach used in this plan incorporates the four priorities enunciated in the Sendai Framework under the six Thematic Areas for Action:

i. Understanding Risk
ii. Inter-Agency Coordination
iii. Investing in DRR – Structural Measures
iv. Investing in DRR – Non-Structural Measures
v. Capacity Development
vi. Climate Change Risk Management

For each thematic area for action, the plan has identified a set of major themes for undertaking actions within the broad planning framework. For each hazard, themes for action are presented in a separate responsibility matrix assigning roles

of centre and state for each of the thematic areas for action. The activities envisaged in NDMP and Sendai Framework fall into short/ immediate (within 5 years), medium (within 10 years), and long-term (within 15 years) categories, which will be implemented in many instances concurrently, and not necessarily sequentially. Some of the actions under immediate response are short-lived, while many of the measures for risk reduction and strengthening resilience are long term, which should become part of all facets of the developmental process through mainstreaming.

Box-1.2: Main Pillars of the DMP of Power Sector

- Conforming to the national legal mandates – DM Act 2005 and NPDM 2009.
- The global goals as per agreements to which India is a signatory – Sendai, SDG and COP21 (Paris Agreement) – consistent with the international consensus for achieving mutual reinforcement and coherence of these frameworks.
- Prime Minister's Ten Point Agenda for DRR articulating contemporary national priorities.
- Mainstreaming DRR as an integral feature.

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Chapter-2

2. Institutional Framework for Disaster Management

2.1 Institutional Framework for Disaster Management at National Level

The overall coordination of disaster management vests with the Ministry of Home Affairs (MHA). The Cabinet Committee on Security (CCS) and the National Crisis Management Committee (NCMC) are the key committees involved in top-level decision-making with regard to disaster management. The NDMA is the lead agency responsible for the preparation of DM plans and the execution of DM functions at the national level.

Figure-2.1 provides a schematic view of the basic institutional structure for DM at the national level. The figure represents merely the institutional pathways for coordination, decision-making and communication for disaster management and does not imply any chain of command.

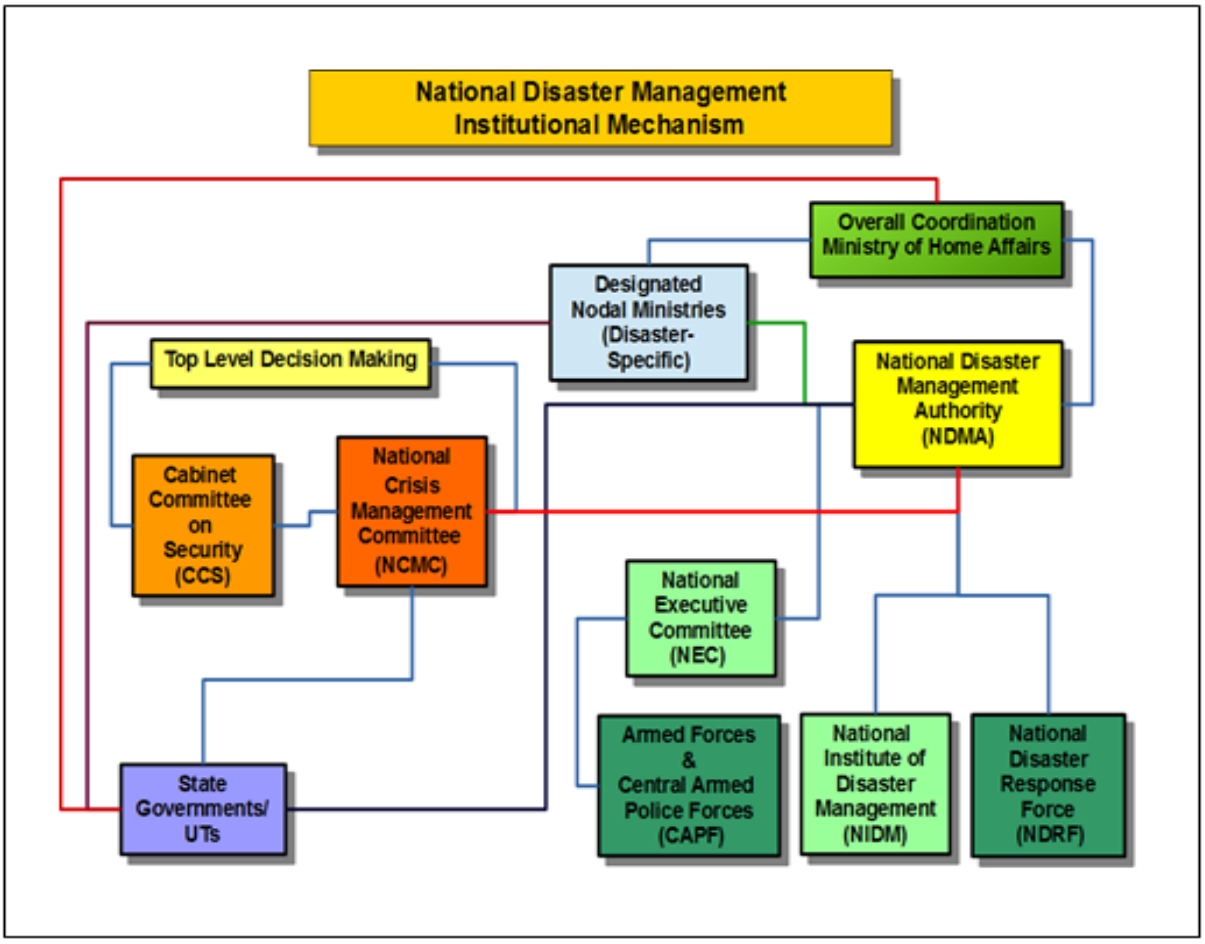

Figure-2.1: National Level Disaster Management - Basic Institutional Framework

In most cases, state governments will be carrying out disaster management with the central government playing a supporting role. The central agencies will participate

only on the request from the state government. Within each state, there is a separate institutional framework for disaster management at the state-level. The DM Act of 2005 provides for setting up of NDMA at national level, and SDMAs at each state level. The role & composition of the key decision making bodies for disaster management at national-level are briefly described in Table-2.1.

Table-2.1: Key decision making bodies for disaster management at national-level

Sl. No.	Name	Composition	Vital Roles
1.	Cabinet Committee on Security (CCS)	Prime Minister, Minister of Defence, Minister of Finance, Minister of Home Affairs, and Minister of External Affairs	• Evaluation from a national security perspective, if an incident has potentially security implications • Oversee all aspects of preparedness, mitigation and management of Chemical, Biological, Radiological and Nuclear (CBRN) emergencies and of disasters with security implications • Review risks of CBRN emergencies from time to time, giving directions for measures considered necessary for disaster prevention, mitigation, preparedness and effective response
2.	National Crisis Management Committee (NCMC)	• Cabinet Secretary (Chairperson) • Secretaries of Ministries / Departments and agencies with specific DM responsibilities	• Oversee the Command, Control and Coordination of the disaster response • Give direction to the Crisis Management Group as deemed necessary • Give direction for specific actions to face crisis situations
3.	National Disaster Management Authority (NDMA)	• Prime Minister (Chairperson) • Members (not exceeding nine, nominated by the Chairperson)	• Lay down policies, plans and guidelines for disaster management • Coordinate their enforcement and implementation throughout the country • Approve the NDMP and the DM plans of the respective Ministries and Departments of Government of India • Lay down guidelines for disaster management to be followed by the different Central Ministries, Departments and the State Governments
4.	National Executive Committee (NEC)	• Union Home Secretary (Chairperson) • Secretaries to the GOI in the Ministries/ Departments of Agriculture,	• To assist the NDMA in the discharge of its functions • Preparation of the National Plan • Coordinate and monitor the implementation of the National Policy • Monitor the implementation of the National Plan and the plans prepared by the

Sl. No.	Name	Composition	Vital Roles
		Atomic Energy, Defence, Drinking Water and sanitation, Environment, Forests and Climate Change Finance (Expenditure), Health and Family Welfare, Power, Rural Development, Science and Technology, Space, Telecommunications, Urban Development, Water Resources, River Development and Ganga Rejuvenation, The Chief of the Integrated Defence Staff of the Chiefs of Staff Committee, ex officio as members. • Secretaries in the Ministry of External Affairs, Earth Sciences, Human Resource Development, Mines, Shipping, Road Transport and Highways and Secretary, NDMA are special invitees to the meetings of the NEC.	Ministries or Departments of the Government of India • Direct any department or agency of the Govt. to make available to the NDMA or SDMAs such men, materials or resources as are available with it for the purpose of emergency response, rescue and relief • Ensure compliance of the directions issued by the Central Government • Coordinate response in the event of any threatening disaster situation or disaster • Direct the relevant ministries/ Departments of the GoI, the State Governments and the SDMAs regarding measures to be taken in response to any specific threatening disaster situation or disaster. • Coordinate with relevant Central Ministries / Departments / Agencies which are expected to provide assistance to the affected State as per standard Operating Procedures (SOPs) Coordinate with the Armed Forces, Central Armed Police Forces (CAPF), the National Disaster Response Force (NDRF) and other uniformed services which comprise the GoI's response to aid the State authorities • Coordinate with India Meteorological Department (IMD) and a number of other specialized scientific institutions which constitute key early warning and monitoring agencies • Coordinate with Civil Defence volunteers, home guards and fire services, through the relevant administrative departments of the State Governments
5.	National Disaster Response Force (NDRF)	Specially trained force headed by a Director General Structured like para military forces for rapid deployment	Provide assistance to the relevant State Government/District Administration in the event of an imminent hazard event or in its aftermath

Sl. No.	Name	Composition	Vital Roles
6.	National Institute of Disaster Management (NIDM)	Union Home Minister; Vice Chairman, NDMA; Members including Secretaries of various nodal Ministries and Departments of Government of India and State Governments and heads of national levels scientific, research and technical organizations, besides eminent scholars, scientists and practitioners.	• Human resource development and capacity building for disaster management within the broad policies and guidelines laid down by the NDMA • Design, develop and implement training programmes • Undertake research • Formulate and implement a comprehensive human resource development plan • Provide assistance in national policy formulation, assist other research and training institutes, state governments and other organizations for successfully discharging their responsibilities • Develop educational materials for dissemination • Promote awareness generation

2.1.1 National Disaster Management Authority (NDMA)

The Government of India established NDMA in 2005, headed by the Prime Minister. Under the DM Act 2005, NDMA, as the apex body for disaster management, shall have the responsibility for laying down the policies, plans, and guidelines for disaster management for ensuring timely and effective response to disaster. The guidelines of NDMA assist Central Ministries, Departments, and States to formulate their respective DM plans. It approves National Disaster Management Plans and DM plans of the Central Ministries / Departments. It takes such other measures, as it may consider necessary, for prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Central Ministries / Departments and State Governments extend necessary cooperation and assistance to NDMA for carrying out its mandate. It also oversees provision and application of funds for mitigation and preparedness measures.

The general superintendence, direction, and control of the National Disaster Response Force (NDRF) is vested in and will be exercised by the NDMA. National Institute of Disaster Management (NIDM) works within the framework of broad policies and guidelines laid down by the NDMA. NDMA has the mandate to deal with all types of disasters – natural or human-induced. However, other emergencies such as terrorism (counter-insurgency), law and order situations, hijacking, air accidents, CBRN weapon systems, which require close involvement of the security forces and/or intelligence agencies, and other incidents such as mine disasters, port and harbour emergencies, forest fires, oilfield fires and oil spills are handled by

the National Crisis Management Committee (NCMC). Nevertheless, NDMA may formulate the guidelines with advice/ inputs drawn from experts of DAE and facilitate training and preparedness activities in respect of response to RN emergencies with technical advice obtained from experts from DAE.

2.1.2 National Institute of Disaster Management (NIDM)

As per provisions of the Chapter-VII of DM Act, Government of India has constituted National Institute of Disaster Management (NIDM) under an Act of Parliament with the goal of being the premier institute for capacity development for disaster management in India and the region. It has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation, and policy advocacy in the field of disaster management. NIDM has built strategic partnerships with various ministries and departments of central, state, and local governments, academic, research and technical organizations in India and abroad and other bilateral and multilateral international agencies. It provides technical support to state governments through Disaster Management Centres (DMCs) in Administrative Training Institutes (ATIs) of States and Union Territories.

2.1.3 National Disaster Response Force (NDRF)

NDRF has been constituted as per Chapter-VIII of the DM Act 2005 as a specialist response force that can be deployed in a threatening disaster situation or disaster. As per DM Act, the general superintendence, direction and control of NDRF shall be vested and exercised by NDMA. NDRF positions its battalions at different locations as required for effective response and these units maintain close liaison with designated State Governments and are available to them in the event of any serious threatening disaster situation. NDRF is equipped and trained to respond to situations arising out of natural disasters and CBRN emergencies. NDRF units also impart basic training to all stakeholders identified by State Governments in their respective locations.

2.1.4 Nodal Ministry for Management / Mitigation of Different Disasters

From time to time, central government notifies hazard-specific nodal ministries to function as the lead agency in managing particular types of disasters.

Table-2.2: Nodal Ministry for Management / Mitigation of Different Disasters

Sl. No.	Disaster	Nodal Ministry/ Department
1.	Avalanche	Ministry of Defence (MoD) – Border Road Organization (BRO)
2.	Biological Emergencies	Min. of Health and Family Welfare (MoHFW)
3.	Chemical and Industrial	Min. of Environment, Forest and Climate Change (MoEFCC)
4.	Civil Aviation Accidents	Min. of Civil Aviation (MoCA)
5.	Cyclone/Tornado	Min. of Earth Sciences (MoES)
6.	Drought/Hailstorm/Cold Wave and Frost	Min. of Agriculture and Farmers Welfare (MoAFW)
7.	Earthquake	Min. of Earth Sciences (MoES)
8.	Flood	Min. of Jal Shakti (MoJS)
9.	Forest Fire	Min. of Environment, Forests, and Climate Change (MoEFCC)
10.	Landslides	Min. of Mines (MoM)
11.	Nuclear and Radiological Emergencies	Dept. of Atomic Energy (DAE)
12.	Tsunami	Min. of Earth Sciences (MoES)

2.2 Institutional Framework for Disaster Management at State Level

As per DM Act of 2005, each state in India shall have its own institutional framework for disaster management. Among other things, DM Act mandates that each State Government shall take necessary steps for preparation of state DM plans, integration of measures for prevention of disasters or mitigation into state development plans, allocation of funds, and establish EWS. Depending on specific situations and needs, State Governments shall also assist Central Government and central agencies in various aspects of DM. Each state shall prepare its own State Disaster Management Plan.

The DM Act mandates setting of a State Disaster Management Authority (SDMA) and a similar system in each Union Territory. At the district level, District Disaster Management Authority (DDMA), District Collector or District Magistrate or Deputy Commissioner, as applicable, will be responsible for overall coordination of disaster management efforts and planning. Figure-2.2 provides a schematic view of a typical state-level institutional framework. The figure represents merely institutional pathways for coordination, decision-making and communication for disaster management and does not imply any chain of command.

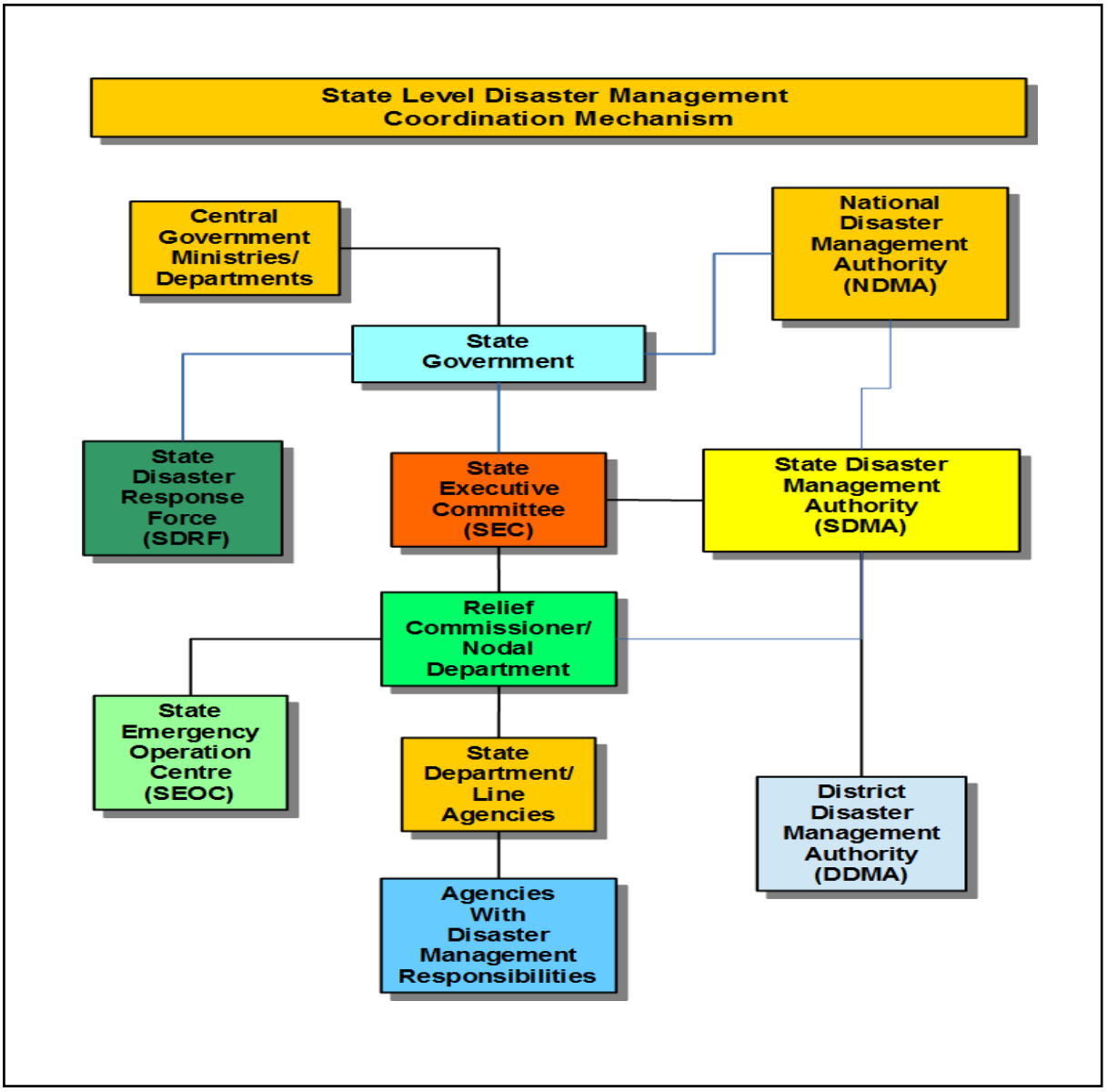

Figure-2.2: State Level Disaster Management - Basic Institutional Framework

2.2.1 State Disaster Management Authority (SDMA)

As per provisions in Chapter-III of the DM Act, each State Government shall establish a State Disaster Management Authority (SDMA) or its equivalent under a different name with the Chief Minister as the Chairperson. In case of other UTs, Lieutenant Governor or Administrator shall be the Chairperson of that Authority.

SDMA will lay down policies and plans for DM in the State. SDMA will approve the disaster management plans prepared by various departments. It will, *inter alia* approve State Plan in accordance with the guidelines laid down by the NDMA, coordinate implementation of the State Plan, recommend provision of funds for mitigation and preparedness measures and review developmental plans of different departments of State to ensure integration of prevention, preparedness and mitigation measures.

2.2.2 District Disaster Management Authority (DDMA)

As per provisions in Chapter-IV of the DM Act, each State Government shall establish a District Disaster Management Authority for every district in the State with such name as may be specified in that notification. DDMA will be headed by District Collector, Deputy Commissioner, or District Magistrate as the case may be, with elected representatives of the local authority as Co- Chairperson. State Government shall appoint an officer not below the rank of Additional Collector or Additional District Magistrate or Additional Deputy Commissioner of the district to be the Chief Executive Officer of the District Authority. DDMA will act as the planning, coordinating and implementing body for DM at the District level and take all necessary measures for the purposes of DM in accordance with the guidelines laid down by NDMA and SDMA. It will, inter alia, prepare DM plan for the District and monitor implementation of all relevant national, state, and district policies and plans. DDMA will also ensure that the guidelines for prevention, mitigation, preparedness, and response measures laid down by NDMA and SDMA are followed by all district-level offices of various departments of State Government.

2.3 Institutional Framework for Disaster Management in Power Sector

As per Section 36 of Disaster Management Act, it shall be the responsibility of every Ministry or Department of the Government of India to —

a) take measures necessary for prevention of disasters, mitigation, preparedness and capacity building in accordance with the guidelines laid down by the National Authority;
b) integrate into its development plans and projects, the measures for prevention or mitigation of disasters in accordance with the guidelines laid down by the National Authority;
c) respond effectively and promptly to any threatening disaster situation or disaster in accordance with the guidelines of the National Authority or the directions of the National Executive Committee in this behalf;
d) review the enactments administered by it, its policies, rules and regulations, with a view to incorporate therein the provisions necessary for prevention of disasters, mitigation or preparedness;
e) allocate funds for measures for prevention of disaster, mitigation, capacity-building and preparedness;
f) provide assistance to the National Authority and State Governments for—
    (i) drawing up mitigation, preparedness and response plans, capacity-building, data collection and identification and training of personnel in relation to disaster management;
    (ii) carrying out rescue and relief operations in the affected area;
    (iii) assessing the damage from any disaster;

(iv) carrying out rehabilitation and reconstruction;

g) make available its resources to the National Executive Committee or a State Executive Committee for the purposes of responding promptly and effectively to any threatening disaster situation or disaster, including measures for—
   (i) providing emergency communication in a vulnerable or affected area;
   (ii) transporting personnel and relief goods to and from the affected area;
   (iii) providing evacuation, rescue, temporary shelter or other immediate relief;
   (iv) setting up temporary bridges, jetties and landing places;
   (v) providing, drinking water, essential provisions, healthcare, and services in an affected area;
   (vi) take such other actions as it may consider necessary for disaster management.

To achieve the above objectives, a four-tier structure has been put in place at Central, Regional, State and Local Unit Levels, with intervention and response depending on the severity of the disaster /calamity for effectively dealing with disaster situations in power sector. Though the prime focus of activities would be at the actual installations that are affected due to the impending or actual event, it is envisaged to have a comprehensive disaster management system in place with initiatives/ support at the regional and central level, especially in case of major disasters affecting the plant, installation or site. While the Central & State Level interventions are necessitated for major calamities, the local agency should respond to minor incidents.

2.3.1 Disaster Management Groups (DMG) in Power Sector

The Disaster Management Groups (DMG) in Power Sector at various levels are outlined below:

a) Central Level Disaster Management Group (CDMG)
b) Regional Level Disaster Management Group (RDMG)
c) State Level Disaster Management Group (SDMG)
d) Local Level Emergency Management Group (EMG)

Central Level Disaster Management Group (CDMG)

Composition:

a) Secretary (Ministry of Power, Government of India) – Chairman.
b) Chairperson, CEA.
c) CMD, Grid Controller of India Limited (Grid – India).
d) Chairman of NPC and RPCs.
e) CMDs of NTPC, NHPC & Power Grid Corporation of India Limited

f) Chairman, Central Water Commission (CWC), for floods related early warnings.
g) Director-General, Indian Meteorological Department (IMD), for Earthquake, and cyclone related early warnings.
h) Director, Indian National Centre for Ocean Information Services (INCOIS), for tsunami related early warnings.
i) A representative of National Disaster Management Authority (NDMA).

Responsibilities:

a) To facilitate the development of comprehensive disaster management plan & policy formulation for the power sector.
b) To interact with the National Disaster Management Authority.
c) To facilitate support from other national & state-level agencies.
d) To coordinate any assistance in terms of men and materials at the national level.
e) To act as an information source desk for all related developments in the event of a disaster.

Regional Level Disaster Management Group (RDMG)

Composition:

a) Member Secretary (RPC) - Chairman
b) Representative of Secretary in-charge of Rehabilitation and Relief of the affected State of the Region
c) Representatives of each State Civil Defence
d) Regional HODs CPSUs (NTPC, NHPC, PGCIL etc.)
e) CMDs State TRANSCOs/Power Departments
f) SLDC in charge of each state.
g) Chief Engineer, Central Water Commission (CWC), for floods related early warnings.
h) Deputy Director-General, Indian Meteorological Department (IMD), for Earthquake, and Cyclone related early warnings.
i) Group Head, Ocean Information and Forecast Services Group (ISG), for Tsunami related early warnings.
j) Head of RLDC

Responsibilities:

a) To interact with CDMG for proper coordination.
b) To ensure that disaster management plans are in place.
c) To provide inter-state emergency & start-up power supply
d) To coordinate the early restoration of the regional grid.
e) To participate in damage assessment.

f) To facilitate resource movement to affected state (s) from other regional states

State level Disaster Management Group (SDMG)

Composition:

a) Principal Secretary / Secretary (Energy) of the State - Chairman
b) MDs of Generation, Transmission, Distribution companies
c) Representatives of health and welfare agencies
d) Chief fire safety officer
e) Inspector General of Police
f) Director, Central Water Commission (CWC) for floods related early warnings
g) A representative from Meteorological Department (IMD) of State for Earthquake and Cyclone related early warnings
h) A representative from Ocean Information Services Centre of State for Tsunami related early warnings.
i) A representative of State Disaster Management Authority (SDMA)
j) SLDC in charge

Responsibilities:

a) To interact with RDMG/CDMG.
b) To mobilize resources for restoration
c) To ensure that disaster management plans are in place
d) To mobilize financial resources
e) To facilitate inter-agency support & coordinate information
f) To facilitate damage assessment

Local Level Emergency Management Group (EMG)

Composition:

a) In-charge of the installation
b) Plant/Substation safety manager
c) Chief Plant/substation Operation Administration
d) A representative of District Administration

Responsibilities:

a) To direct action in the affected area taking into consideration the priorities for the safety of plant/sub-station personnel, minimize damage to plant/substation, property and the environment.
b) To direct fire and security personnel for immediate action.
c) To ensure that all non-essential workers/staff in the affected area are evacuated to safer places

d) Set up communication points
e) Report all development and requirements/ assistance needed
f) Preserve all evidence so as to facilitate any inquiry into the cause and circumstances which caused or escalated the emergency
g) To coordinate with District Administration for necessary finance, medical facilities law & order etc.

This Emergency Management Group (EMG) shall also maintain the following:

a) Safety data pertaining to all hazardous materials likely to cause an emergency.
b) Procedure of major and special firefighting materials etc.
c) Procedures for tackling harmful gases and other chemical leakages.
d) Emergency call out list of persons for emergency control, key personnel, fire safety, First aid, Medical, Security, police and District Administration Authorities.
e) Emergency manuals, Blown up area maps, District Public address system, Emergency lights etc.
f) Identification of personnel for Mock drills & training.
g) List of essential raw materials, spares, tools and safety kits & its arrangement to fight emergency situations, ensure public safety, and faster restoration of supply.
h) List for agencies with contact numbers for outsourced manpower, special services and necessary plan.

Role and Responsibilities of Disaster Management Groups

Table-2.3: Role and Responsibilities of Disaster Management Groups

Sl. No	Disaster Management Group	Prevention	Preparedness	Mitigation	Relief & Response Activity
1	Central Level Disaster Management Group (CDMG)	Facilitate development of comprehensive disaster management plan and policy for power sector.	➢ Coordinate for any assistance in terms of men and material at national level. ➢ Interact with the national disaster management group	Act as information source desk for all related development in the event of disaster.	Facilitate support from other national and state level agencies
2	Regional Level Disaster Management Group (RDMG)	Provide interstate emergency & start up power supply	Coordinate early restoration of regional grid.	Participate in damage assessment	Facilitate resource movement to affected state(s) from other states.

3	State Level Disaster Management Group (SDMG)	Ensure that disaster management plans are in place.	➢ Coordinate information. ➢ Facilitate inter-agency support	➢ Mobilize resources for restoration. ➢ Facilitate damage assessment	Mobilize financial resources.
4	Local Level Emergency Group(EMG)	➢ Maintain safety data pertaining to all hazardous materials likely to cause emergency. ➢ Maintain the procedure for tackling harmful gases and other chemical leakages. ➢ Maintain the procedure of major and special firefighting equipment.	Set up communication points.	➢ Ensure that all non-essential workers/staff in the affected area are evacuated to safer places. ➢ Direct action in the affected area taking into consideration the priorities for safety personnel, minimize damage to plant, property and environment.	Coordinate with district administration for necessary finance, medical facilities.

Inter-Group Relationships in DM System of Power Sector

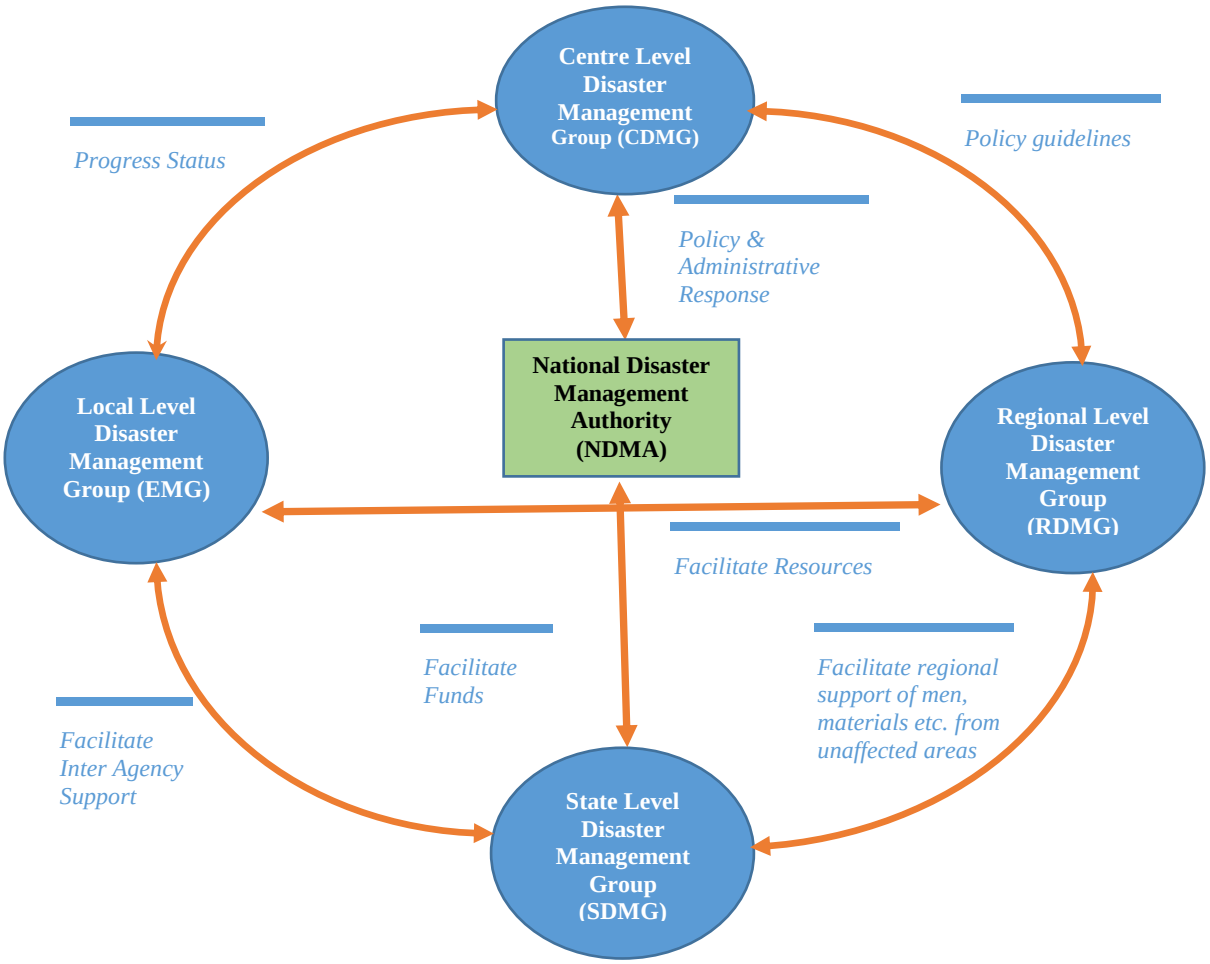

Figure-2.3: Inter-group relationships in Disaster Management System of Power Sector

2.3.2 Emergency Operation Centers (EOCs)/Control Rooms in Power Sector

An Emergency Operation Centre (EOC) i.e. a centralized facility with full communication infrastructural facilities, should be set up at each power establishment level from which Disaster related operations are directed and coordinated. The objective of the EOCs shall be to provide centralized direction and control of any or all of the following functions:

i. Receive and process disaster alerts and warnings from nodal agencies and other sources and communicate the same to all designated authorities;
ii. Monitor emergency operations;
iii. Requisition additional resources during the disaster phase;
iv. Issue disaster/incident specific information and instructions specific to all concerned;
v. Consolidation, analysis, and dissemination of damage, loss and needs assessment data;
vi. Forward consolidated reports to all designated authorities;
vii. Facilitate coordination among internal departments and external agencies;

Resources at EOCs/Control Rooms

The EOCs/Control Rooms shall have the following resources to effectively handle Crisis/disasters –

i. State-of-the-art communication facilities (conventional and alternative communication systems) for seamless communication during threatening disaster situations or disasters. It should have hot line and radio communication facility with all operational and vital functional departments within the organization and external stakeholders e.g., control room of Meteorological Department, Police, Fire Service, Municipal Corporation, parallel utilities within the state (if any), SLDC & RLDC (State & Regional load dispatch Centre), State DM Cell, Civil Defense, Medical Services etc.
ii. Necessary IT support, disaster dashboard facility & connectivity with Distribution Companies, SCADA & breakdown management system, so that monitoring of network outage, list of breakdowns and off supply of VVIP consumer & vital installations e.g. Police Station, Fire Station etc. can be directly viewed and necessary guidance for faster restoration/rebuilt of the system can be generated.
iii. Backed up power with emergency lighting etc.
iv. Contact list and number of fire stations, medical centers, security, police and district administration & authorities.
v. First aid procedure.

vi. Disaster management manuals, blown up area maps, district phone directories.
vii. Contact list of key personnel within the organization.
viii. Complete detail of the system and guiding document for bulk supply failure.
ix. Site plans, facility description, various drawings and maps of the facility describing the electrical fittings, availability of the firefighting equipment, floor wise plan of evacuation etc.
x. Safety data pertaining to all hazardous materials, which are likely to cause emergency.
xi. Procedure of major and special firefighting, rescue operations, First Aid etc.
xii. The EOC building should be disaster resistant, so as to withstand the impact of disasters and remain functional during the emergency phase.
xiii. Functionalities and features available in EOCs should be periodically checked and should be suitably upgraded as per requirement.

Back up EOC/ Control room should also be set up preferably at remote location & kept ready to manage adverse situations if main control room dysfunctions or gets affected due to any disaster. Back up control room should be set up keeping all important features/functions of main control room with full access control so that officials can operate the entire system without any difficulty. Backup control room should be tested periodically for intended functionality by making it main control room.

Control Room at National/Regional/State/Local level

It is essential to have an integrated approach at the national level to monitor and effectively deal with the emergency situations arising out of disasters in the power sector. It is, therefore, decided to have a four-tier control system as follows:

a) National Load Despatch Centre (NLDC) as Central Control room with headquarters at New Delhi.
b) Regional/ Load Despatch Centres (RLDCs) as Regional control room.
c) State Load Despatch Centres (SLDCs) as State level control room.
d) Field level (Power Plant / Grid sub-station) level control room.

The main objective of effective coordination amongst the control rooms will be to pool in all the possible resources to effectively handle emergency situations in power sector. The control rooms are entrusted to collect all the information and compile it for timely communication with the concerned people and they should operate round the clock.

Ministry of Power, Government of India has designated National Load Despatch Centre (NLDC) as Central Control room to deal with Crisis/disasters in the power sector and Head of NLDC is designated as the nodal officer. It is entrusted with the responsibility of creating "Weather Portal of Power Sector" for collating information from various sources and issuing advisories to the concerned utilities in case of an anticipated disaster affecting power system for secure and reliable operation of the grid. To facilitate dissemination of information by the Nodal Officer of Central Control Room, effective coordination of NLDC with the nodal officer(s) of RLDCs and in turn SLDCs is of vital importance for which laid down mechanism may be adopted. In addition, the interface of Central control room with nodal officers of Central Public Sector Undertakings (CPSUs) as well as State level control rooms is also required.

Nodal Officer, Central Control Room would act as an information source desk for all related developments in the event of a disaster. The concerned RLDC would be Regional Control Centre in case of disaster and RLDC in-charge would act as the Nodal Officer for the same. The State level nodal officer(s) would be required to interact with the State GENCO/TRANSCO/DISCOMs as well as Regional control rooms depending upon the magnitude of emergency situations.

Box-2.1: Overall Institutional Framework for DM at National Level:

- The overall coordination of disaster management vests with the Ministry of Home Affairs (MHA).
- The Cabinet Committee on Security (CCS) and the National Crisis Management Committee (NCMC) are the key committees involved in the top-level decision-making with regard to disaster management.
- NDMA is the lead agency responsible for preparation of DM plans and execution of DM functions at the national level.

Box-2.2: Institutional Framework for DM in Power Sector:

- A four-tier structure at Central, Regional, State and Local Unit Level, with intervention and response depending on the severity of the disaster /calamity for effectively dealing with disaster situations in power sector:
  - Central Level Disaster Management Group (CDMG)
  - Regional Level Disaster Management Group (RDMG)
  - State Level Disaster Management Group (SDMG)
  - Local Level Emergency Management Group (EMG)
- A four-tier control system as well:
  - National Load Despatch Centre (NLDC) - Central Control room
  - Regional/ Load Despatch Centre (RLDCs) - Regional control room.
  - State Load Despatch Centre (SLDCs) - State level control room.
  - Field level (Power Plant / Grid sub-station) - Local level control room.
- Ministry of Power, Government of India has designated National Load

Chapter-3

3. Hazard Risk and Vulnerability Analysis (HRVA)

As per the definition adopted by UNISDR,

> *"Hazard is a dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage".*

Hazards, natural as well as humanly induced, can result in disaster. The occurrence of a given hazard becomes disaster risk when human stakes (e.g., assets, lives, and socioeconomic or environmental values) are exposed and vulnerable to the hazard.

India has a highly diversified range of natural features. Its unique geo-climatic conditions make the country among the most vulnerable to natural disasters in the world. Disasters occur with very high frequency in India and while the society at large has adapted itself to these regular occurrences, the economic and societal costs continue to rise. The natural disasters or hazards, which the country has experienced in the past, not only caused huge losses to the affected states/ country in terms of human lives, property, revenue, but also caused huge losses to the power sector in terms of damage of electrical infrastructures causing severe power outages.

3.1 Hazard Risk and Vulnerability Mapping

Vulnerability may be defined as the degree to which a system is susceptible to or unable to cope with the adverse effects of a hazard. India has been vulnerable, in varying degrees, to a large number of natural, as well as human-made disasters on account of its unique geo-climatic topographic features, environmental degradation, population growth, urbanisation, industrialization, non- scientific development practices and socio-economic conditions. The factors either in original or by accelerating the intensity and frequency of disasters, are responsible for the heavy toll of human lives and disrupting the life support system in the country. Clearly, all these contribute to a situation where disasters seriously threaten India's economy, its population and sustainable development. In fact, India is one of the ten worst disaster prone countries in the world.

The basic reason for the high vulnerability of the country to natural disasters is its unique geographical and geological situation. As far as the vulnerability to disaster is concerned, the distinctive regions of the country i.e. Himalayan region, the alluvial plains, the hilly part of the peninsula desert, and the coastal zone have their own specific problems. While on one hand, Himalayan region is prone to

disasters like earthquakes and landslides, plains are affected by floods almost every year. The desert part of the country is affected by droughts and famine, while the coastal zone is susceptible to cyclones and storms. Almost 58.6 percent of the landmass is prone to earthquakes of moderate to very high intensity; over 40 million hectares (12 percent of land) are prone to floods and river erosion; of the 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis; 68 percent of the cultivable area is vulnerable to drought and the hilly areas are at risk from landslides and avalanches.

3.2 Disaster Risks in Power Sector

Disaster in the power sector can occur mainly due to the following hazard:

- Fire / Forest fire
- Cyclones
- Floods/cloud bursts/urban floods
- Earthquakes
- Tsunamis
- Landslides
- Thunderstorm & Lightning, Squall, Dust Storm, and Strong Wind
- Pandemic / Epidemic
- Environment and Climate Change

3.2.1 Fire / Forest fire

Fires can start due to human activities or from natural causes. Forest fires can start from either natural causes or human activity or from a combination of both. The most common fires are usually caused by human activities such as human errors, faulty designs, or mechanical failures. Fire can also be the secondary effect of a disaster like earthquake that constitutes a substantial and heavy risk. Damages to electrical systems during a disaster can ignite major fires.

Fire is a big threat and causes loss to human life and property. However, disasters due to fire normally remain localized to a particular installation until and unless tripping of the entire power plant causes disturbance in the transmission grid by way of overloading and leading to tripping of other power stations/ transmission lines connected to the grid.

Fire/Forest fires can directly damage transmission towers and other electricity infrastructure. In case of forest fire, the greatest risk comes from smoke and particulate matter, which can ionize the air around the transmission line thereby creating a conducting path for electricity resulting into phase to phase or phase to ground fault and may lead to shut down of the lines. Dense smoke from forest fire can “trip” a circuit, causing it to go out of service, or outages can result from

emergency line de-rating or shutdowns. When a forest fire occurs, assets like wooden poles and power cables in the vicinity can burn. Steel towers are also vulnerable to heat from forest fires. The conductors of transmission lines are susceptible to physical damage from the heat of a forest fire, and conductor damage may not be repairable and may need replacement. A forest fire can force the outage of a transmission circuit if it raises the ambient temperature of the air around the conductors above the line's operating parameters. Heavy smoke from a nearby forest fire can contaminate a transmission line's insulating medium, which is the air surrounding the conductor.

3.2.2 Cyclones

When a cyclone approaches the coast, a risk of serious loss or damage arises from severe winds, heavy rainfall, storm surges and river floods. Also, cyclonic storm is a very common threat to power sector in landlocked states. A severe cyclone / cyclonic storm disrupts electric power supply of the affected areas as it causes damage to transmission/distribution assets and in some cases even by uprooting them completely or partially. In high-speed windstorm / cyclonic storm, conductors of transmission lines may snap or transmission line towers may collapse due to excessive torsional loading.

3.2.3 Floods/Flash Flood/Cloud Burst/Urban Flood

The main causes of floods are heavy rainfall, inadequate capacity of rivers to carry high flood discharge, inadequate drainage to carry away rainwater quickly to streams/ rivers, ice jams or landslides blocking streams. Typhoons and cyclones also cause floods. Flash floods occur due to high rate of water flow and also due to poor permeability of the soil. Areas with hardpan just below the surface of the soil are more prone to floods as water fails to seep down to the deeper layers.

Floods/Flash Flood/Cloud Burst may lead to damage to electrical equipment causing power outages. The erosion due to the floodwaters, and landslides triggered by floods, have severely damaged the foundations of transmission towers in the past. Due to floods, the hydro-generator may also be shut down and the assets can be washed away. Flooding of transmission substations and distribution substations may lead to blackouts in the area being serviced by the sub-station.

Urban Flood:

The problem of urban flooding is a result of both natural factors and land-use changes brought about by urban development. Urban flooding is significantly different from rural flooding as urbanisation leads to developed catchments which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times, sometimes in a

matter of minutes. It is caused by the combination of meteorological, hydrological, and human factors.

The problems associated with urban floods range from relatively localised incidents to major incidents, resulting in inundation of some or large parts urban areas for several hours to many days. It may result in damage to property, relocation of people and loss of life. It can also cause disruptions in transport and power supply bringing life to a grinding halt. Most cities in India that get flooded have experienced loss of lives and damage of property, disruptions of power, transport and communications and incidences of epidemics during the monsoons.

3.2.4 Earthquake

Wide-spread human and material losses, collapse of infrastructure and services may be the major consequences of the earthquake. Earthquakes over 5.5 magnitudes on the Richter scale are progressively damaging to property and human life. Globally, earthquakes result in a loss of about 50,000 lives every year.

Insofar as the impact of earthquakes on the power sector is concerned, it may damage the power establishments including the control rooms. It can damage heavy equipment such as generators, transformers, brittle items (like ceramics), and foundation of the electrical equipment. Earthquakes may cause damage to tower foundation that may lead to tower collapse. Earthquakes may also cause a threat to substation equipment and can cause power disruption. Soil liquefaction may also cause damage to electric infrastructure assets.

3.2.5 Tsunami

A tsunami is a series of water waves caused by displacement of a large volume of a body of water, usually in an ocean and it happens after centuries of energy build-up within the earth. Seismically generated tsunamis are result of abrupt deformation of sea floor resulting in vertical displacement of the overlying water. It may be caused by non-seismic events also such as a landslide or impact of a meteor. The release of energy produces tsunami waves that have small amplitude but a very long wavelength (often hundreds of kilometers long).

Tsunami in the deep ocean may have a very long wavelength of hundreds of kilometers and travels at about 800 km per hour, having an amplitude of only about 1 m and therefore, remains undetected by ships in the deep sea. However, when it approaches the coast its wavelength diminishes but amplitude grows enormously, and it takes very little time to reach its full height. Tsunamis have the potential of causing significant casualties, widespread property damage, massive infrastructure loss and long-term negative economic impacts.

Insofar as the impact on power sector is concerned, tsunamis may cause catastrophic damage to electricity infrastructures such as streetlights, switchboards, distribution boxes, power cables/lines and electric poles supporting these power cables/lines, which may cause huge population of the affected areas to remain without electricity for several days.

3.2.6 Landslides and Snow Avalanche

Landslides have been a major and widely spread natural disaster that often affects life and property, leading to a major concern. Insofar as the impact of landslides on power sector is concerned, it may damage the foundation of the electrical equipment, cause damage to tower foundation that may lead to tower collapse, damage substation equipment, cause flooding in power plant, damage its installation and stop electricity generation that may ultimately result in the power disruption. Landslides in the upstream & downstream of reservoir may cause formation of artificial reservoirs, which results in flash floods leading to severe impact on the downstream structures/property, roads, habitants, etc. Landslides may cause flooding of power plants, damage to its installations and stoppage of electricity generation.

3.2.7 Thunderstorm & Lightning, Squall, Dust Storm & Strong Wind

Thunderstorm/Lightning, Dust/Hailstorm, Squall, and Strong Wind are hazardous and cause risk to life and public property. They are potentially hazardous for aviation sector as well as to transport, power, communication and other socio-economic sectors. Data for the last ten years indicates that about 2,500 people died from lightning strikes and torrential rains in the country every year. India may also witness an increase in the severity and frequency of the dust storms and thunderstorms. Experts also believe that the severity and frequency of thunderstorm/dust storms are expected to rise in years ahead due to rising global temperatures. The increase in occurrence and severity is a wake-up call for all agencies to take appropriate action for prevention, preparedness and mitigation in order to save lives, livestock, property and infrastructure.

Thunderstorms

A thunderstorm is said to have occurred if thunder is heard or lightning seen. Considering the intensity, thunderstorms in India are categorised as moderate and severe thunderstorms as follows:

- Moderate thunderstorm: Loud peals of thunder with frequent lightning flashes, moderate to strong rains and maximum wind speed 29 to 74 kmph.
- Severe thunderstorm: Continuous thunder and lightning, strong rains and maximum wind speed ≥ 75 kmph.

Thunderstorms have some important characteristics such as formation of Squalls, strong updrafts and downdrafts, towering cumulonimbus associated with turbulence and icing, in-cloud electrification and associated lightning, localized heavy rain and hailstorm.

Squall

A squall is defined as a sudden increase of wind speed by at least 29 kmph (16 knots) with the speed rising to 40 kmph (22 knots) or more and lasting for at least one minute. The squalls are of two types:

- Moderate squall - Surface wind speed (in gusts) < 80 kmph
- Severe squall - Surface wind speed (in gusts) > 80 kmph

Dust Storm

Dust storms are of three types:

- Slight - Wind speed < 41 kmph, Visibility is 500 to 1000 metres.
- Moderate – Wind speed is 42 to 79 kmph, Visibility is 200 to 500 metres.
- Severe - Wind speed > 80 kmph, Visibility is less than 200 metres.

Lightning

Lightning is a high-current electric discharge that occurs in the earth's atmosphere and that has total path length on the order of few kilometers. The peak power and total energy in lightning are very high with the peak power discharge in the order of 100 million watts per meter of channel and the peak channel temperature approaching 30,000 °C. Peak currents in a lightning discharge range from several to hundreds of kiloamperes (kA), with typical value being 40 kA.

In the atmosphere, three types of discharges take place: a) Thundercloud (intra-cloud), b) One cloud to another (inter-cloud) and c) Cloud to ground (CG). Aircrafts can be hit by the first two while the third type takes a toll on life and property on the ground. Predicting the precise time and location of lightning is very difficult. However, a season or a period of lightning occurrence is known for many regions.

A severe thunderstorm/squall/dust storm may disrupt electric power supply of the affected areas as it causes damage to transmission/distribution assets. Lightning is also a major cause of electrical power breakdowns as it affects the performance of power lines by both direct (direct lightning strike on line conductors, towers, shielding wires etc.) and indirect (lightning striking the ground or any object close to a line propagates the electromagnetic fields in all directions resulting in induced overvoltage in the power system that may cause significant problems) ways.

3.2.8 Pandemic / Epidemic

Pandemic / Epidemic may have catastrophic effects as they are capable of causing large-scale mortality and morbidity as seen in the case of Covid-19 recently. Such biological emergencies are caused by infectious agents that may break naturally, accidentally or deliberate dispersal of such harmful agents into food, water, air, soil or into plants, crops, or livestock. As a large number of people now travel within and across national boundaries, the likelihood of fast global spread of epidemics has increased dramatically making localised outbreaks into national epidemics and global Pandemic / Epidemic.

The power sector is generally not considered as the frontline sector against the battle with a pandemic/epidemic. However, functioning of public health services, the most strained sector during an event of a pandemic/epidemic outbreak, is largely dependent on the round the clock reliable supply of electricity. Apart from powering hospitals and other lifesaving medical equipment and procedures, electricity is also essential for safe water treatment, sanitary waste treatment systems, food refrigeration processes, and vaccine/medicine/medical equipment manufacturing plants to supplement the response efforts during a pandemic/epidemic situation. In addition, availability of electricity supports economy and helps in bringing down life at normalcy so that the possibility of any cascading disastrous event could be avoided.

However, pandemic/epidemic situation impacts the power sector also which may make ensuring uninterrupted power supply a very challenging task. Therefore, appropriate strategies should be planned to ensure that operations and infrastructure are properly supported to provide reliable electricity throughout an emergency.

In the short term, the continuity of the operation of the electricity system is based on guaranteeing the availability of key workers, their infrastructure and technological platforms, as well as having vital supplies such as fuels and spare parts. In the medium and long term, mechanisms will be required to ensure financial and operational viability of the power utilities. Major challenges that may arise in pandemic/epidemic situations are as follows:

a) Employee absenteeism and disruption in transportation & goods and services supply chain network (global, national, regional & local) may lead to the availability of required resources such as fuel, man and material etc. very unpredictable that require integrated response plans involving various stakeholders.
b) The power utilities may struggle even in meeting up the operational and maintenance expenditure to keep the electrical power system up and running due to the possible revenue shortfall.

c) The augmentation plan may get derailed due to financial crunch and also due to disruption in national as well as international supply chains.
d) The fluctuation in power demand and changes in the consumer category mix may pose operational challenges to deal with that needs to be addressed in real time.

3.2.9 Environment and Climate Change

Climate change is already bringing more intense, more frequent, and long-lasting heat waves in all parts of the world, including India. Three climate-change phenomena will particularly have - more impact on the energy sector viz. global warming, changing regional weather patterns (including hydrological patterns) and an increase in extreme weather events. Not only these phenomena will affect energy demand, but they will also affect the entire spectrum of energy production and transmission in some regions.

The power sector has affected the environment adversely as generation of electricity by thermal power plants is one of the main sources of CO_2 emissions in India. On the other hand, environment and climate change also have some significant effects on the power sector as outlined below:

- Thermal power plants will be affected by the decreasing efficiency of thermal conversion as a result of rising ambient temperatures. Reduced water for cooling and increasing water temperatures could lead to reduced power operations or temporary shutdowns.
- Changing weather patterns and extreme weather events present challenges to solar and wind energy. An anticipated increase in cloudiness in some regions would affect electricity generation from solar technologies, while an increase in the number and severity of storms could damage both wind turbines and solar panels.
- Extreme weather events pose a major threat to all power plants but particularly to nuclear plants, where they could disrupt the functioning of critical equipment and processes that are indispensable to safe operation including reactor vessels, cooling equipment, control instruments and back-up generators.
- Changing regional weather patterns are likely to affect the hydrologic cycle that underpins hydropower generation. In some regions, a decline in rainfall levels and a rise in temperature, leading to increased water loss, could result in reduced or more intermittent ability to generate electricity.
- Thermo-electric power plants are generally established near water bodies (seas or large rivers) for easy accessibility of water for cooling towers. Rising sea levels could pose the threat of coastal flooding engulfing the power plants also.

- The changing weather pattern and extreme weather events are likely to affect the vegetation pattern/vegetation cover and could result in higher sediment inflow in the reservoir, which would reduce reservoir capacity and generation.
- Environment and Climate Change may affect the operation of the transmission system. High wind speed could lead to excessive loading on transmission line towers.

3.3 Disaster Zoning

The concept of disaster zoning identifies the areas having similar parameters on average particularly with respect to disasters caused by natural hazards. The impacts of the disasters and their multiplier effects on the economy, national development and severity of affected infrastructures are well known and need to be adequately quantified. Natural calamities like earthquakes, cyclones /cyclonic storms/hurricanes, floods, tsunamis etc. have been scientifically and statistically studied based on data collected the world over. It has become possible to predict their intensities with a certain degree of confidence so that structures/equipment/machinery etc. can be designed to withstand the effect of these forces. Seismic loads as well as wind loads have been measured/instrumented in the country by various organizations like India Meteorological Department (IMD), Geological Survey of India (GSI) etc. As regard to floods, Central Water Commission (CWC) has established a network of Gauge & Discharge (G&D) sites for the measurement of various parameters of discharge of major rivers and forecasting the floods.

In every disaster, electricity infrastructure including buildings, tall structures, power generation plants, transmission towers, conductors, substations, Ring Main Units (RMU) in distribution etc. are vulnerable to damage. Therefore, suitable margins and factors of safety are to be considered in the design of structures to sustain the severity according to the zone characteristics. However, intensity, suddenness and extent of any natural calamity are beyond any perfect assessment and have to be effectively managed in the event of its occurrence.

3.3.1 Cyclone Prone Zone

The major natural disaster that affects the coastal regions of India is cyclone. India has a coastline of about 7516 kms and about 71 percent of this area is in ten states (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Odisha and West Bengal). The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones. The effect of a storm surge is most pronounced in wide and shallow bays exposed to cyclones such as in the northern part of Bay of Bengal. On average, five or six tropical cyclones occur every year, of which two or three could be severe. Most cyclones occur in the Bay of Bengal

followed by the Arabian Sea and the ratio is approximately 4:1. India is exposed to nearly 10 percent of the world's tropical cyclones.

IMD has been working in predicting cyclonic events with the help of satellites and numerical weather prediction tools and it can be done accurately up-to 12 hours' validity.

Table-3.1: Cyclonic events and their damage as defined by IMD

Sl. No.	Cyclone Type	Wind Speed (km/h)	Inundation distance from coast	Damage
1	Severe	88-117	Upto 5 km	Moderate
2	Very Severe	118-167	Upto 10 km	Large
3	Extra Severe	168-221	Upto 10-15 km	Extensive
4	Super	222 & above	Upto 40 km	Catastrophic

In India, cyclones of catastrophic nature have been witnessed. In some cases, more than 260 km/h wind speeds have also been recorded. Thus, an adequate factor of safety needs to be considered while designing power infrastructure.

Zoning for Wind Load

IS 875 Part-III indicates the wind speeds and wind load intensities in various parts of the country based on measured and collected data on wind speeds. The classification of zones as per wind speed and cyclone in India is given in Table-3.2.

Table-3.2: Cyclone Zones in India

Sl. No.	Risk Zone	Basic Wind Speed (m/s)
1.	Very High Damage - A	55
2.	Very High Damage - B	50
3.	High Damage	47
4.	Moderate Damage - A	44
5.	Moderate Damage - B	39
6.	Low Damage	33

The Wind hazard map of India is available at **Appendix–I**.

3.3.2 Flood Zone

India is one of the most flood prone countries in the world. The principal reasons for flood lie in the very nature of natural ecological systems in this country viz. monsoon, highly silted river systems and steep and highly erodible mountains, particularly those in the Himalayan ranges. The average rainfall in India is 1150 mm with significant variation across the country. The annual rainfall along the Western Coast and the Western Ghats, Khasi Hills and over most of the

Brahmaputra Valley amounts to more than 2500 mm. Most of the floods occur during the monsoon period and are usually associated with tropical storms or depressions, active monsoon conditions and break monsoon situations.

23 of the 36 states and union territories in the country are subject to floods and 40 million hectares of land, roughly one-eighth of the country's geographical area, are prone to floods. Floods occur in almost all rivers basins in India.

Table-3.3: Areas liable to Floods in India

Areas liable to Floods in India
Region/States
Punjab, Uttar Pradesh, Northern Bihar, West Bengal, Assam, Arunachal Pradesh, Odisha, Coastal Andhra Pradesh, Telangana, Kerala, Parts of Gujarat, Kashmir Valley

The flood hazard map of India is available at **Appendix-II**.

Flood Plain Zoning

The basic concept of flood plain zoning is to regulate land in the flood plains in order to restrict the damage by floods, which are likely to occur from time to time. It aims at determining the locations and the extent of areas likely to be affected by floods of different magnitudes/frequencies and to develop these areas in such a fashion that reduces damage to a minimum. CWC has carried out flood plain zoning in some of the river basins in the country. The flood zones have been classified in the following three categories as shown in Figure-3.1:

a) Prohibitive zone
b) Restricted zone
c) Warning zone

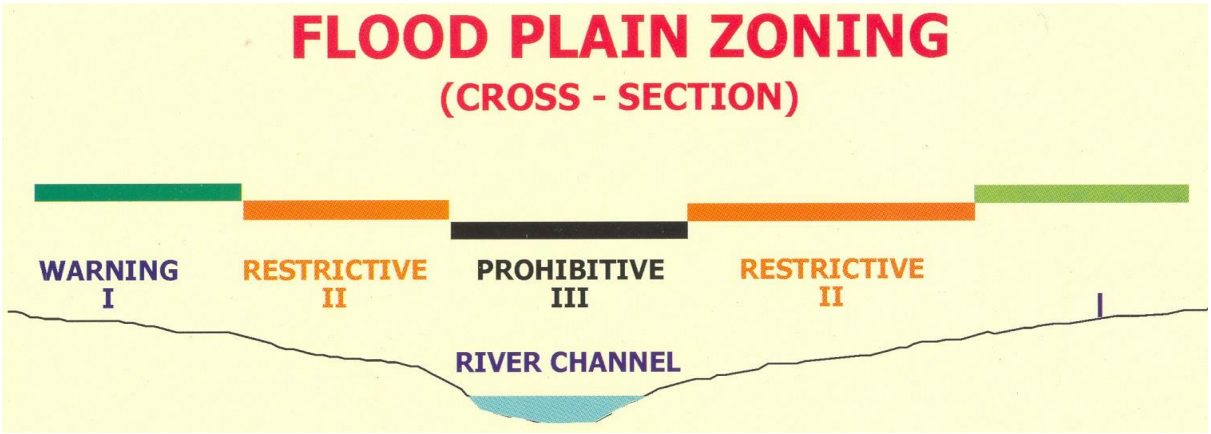

Figure-3.1: Flood Plain Zoning

For the purpose of regulating land use in different flood zones, different types of buildings and utility services have been grouped under three priorities as given below:

Priority-1: Defence installations, industries and public utilities like hospitals electrical installation, water supply, telephone exchange, aerodromes, railway stations, commercial centres, etc.,

Priority-2: Public institutions, Government offices, Universities, Public Libraries and Residential Areas

Priority-3: Parks and Playgrounds

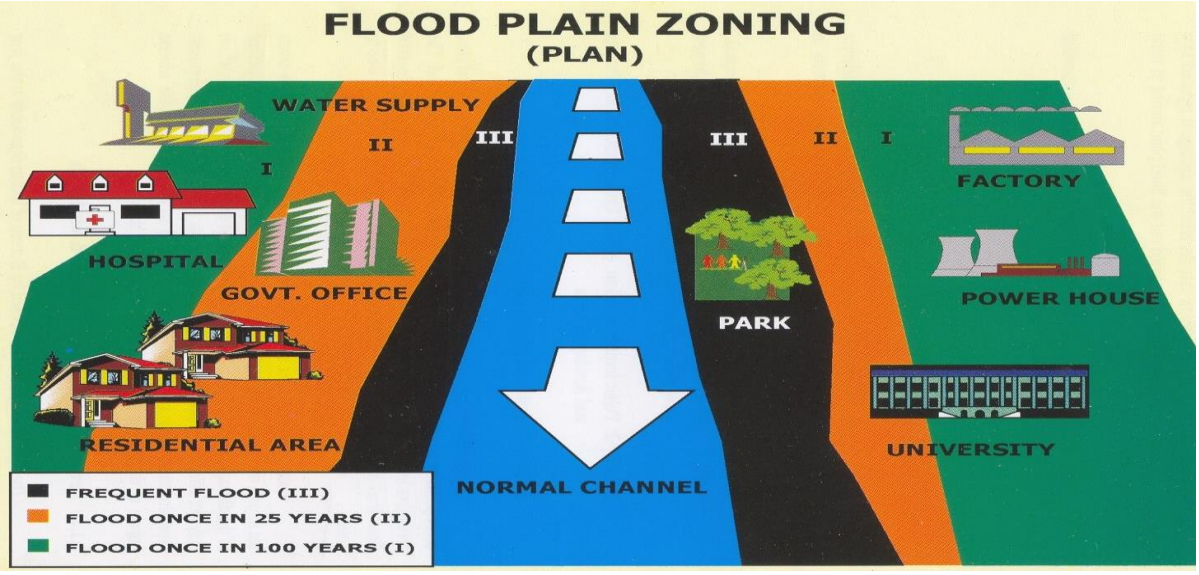

Figure-3.2: Flood Plain Zoning Plan

3.3.3 Earthquakes Zone

The Indian subcontinent is very prone to earthquakes and some of the most intense earthquakes of the world have occurred in India. The entire Himalayan region is considered to be vulnerable to high intensity earthquakes of a magnitude exceeding 8.0 on the Richter Scale. Scientific publications have warned that very severe earthquakes are likely to occur anytime in the Himalayan Region, which could adversely affect the lives of several million people in India.

The extent of the impact of an earthquake depends on its magnitude, location and time of occurrence. Bureau of Indian Standard (BIS) code IS 1893 (Part 4) deals with the earthquake resistance design of various structures including structures for power plants. As per the code, the country has been demarcated from the point of view of the intensity of seismic loads in four Zones i.e. Zone-II to Zone-V.

Table-3.4: Earthquake Zones in India

Sl. No.	Zone	Region / States
1.	Zone V	Kashmir, the western and central Himalayas, North Bihar, the North-East Indian region and the Rann of Kutch
2.	Zone IV	Indo-Gangetic basin including Delhi, Jammu and Kashmir, Parts of Maharashtra, Gujarat
3.	Zone III	Coastal Areas, Andaman and Nicobar Islands, Parts of Kashmir, Western Himalayas
4.	Zone II	Most of Deccan & Chota Nagpur Plateau, Rajasthan

The earthquake hazard map of India is available at **Appendix–III**.

3.3.4 Tsunami Genic Zone

Not all major earthquakes are tsunami genic and according to Indian National Centre for Ocean Information Services (INCOIS), for tsunamis to hit the Indian coast, it is necessary that earthquakes of magnitude more than 7.0 on Richter scale should normally occur. The possible zones for such an event to occur are Andaman - Sumatra or Makran (Pakistan).

The map of potential tsunami genic zones is available at **Appendix–IV**.

3.3.5 Landslide Zone

Landslides mainly affect Himalayan region, Western Ghats of India and also Nilgiri range. It is estimated that 30 percent of the world's landslides occur in the Himalayas. The unprecedented rains in the Nilgiris region in 1978 alone had triggered about one hundred landslides which caused severe damage to communication lines, tea gardens and other cultivated crops.

There have been marked improvements in the quality, timeliness and lead time of hazard warnings, mainly driven by scientific and technological advances. For landslide monitoring, identifying the incipient instability of slopes and early warning of ensuing landslides is possible through systematic mapping, slope instrumentation, monitoring and real-time data analysis. Modern technology offers a number of high-resolution instruments that can capture, monitor and transmit data for real-time analysis and forecasting. Simple devices commonly used for early warning against landslides in the recent past are wire or special switches, actuated by the pressure of moving debris to give signal, electrical switch poles which turn to an upright position upon displacement, photo-electrical barriers especially for rapidly moving debris flows or earth flows and pulsed radar for snow avalanches.

The Landslide hazard zone map of India is available at **Appendix–V**.

3.3.6 Thunderstorm & Lightning, Squall, Dust Storm & Strong Wind Zones

Thunderstorms

Thunderstorms occur round the year in different parts of the country. However, their frequency and intensity are maximum in summer months (March to June). As the most important factor for the occurrence of thunderstorms is the intense heating of the atmosphere at surface level and maximum heating takes place in summer months, the frequency of occurrence is maximum in summer months.

The thunderstorm incidence map of India is available at **Appendix–VI**.

Squall

The frequency and intensity of squalls are maximum over eastern and north-eastern states. Comparing different seasons, the frequency of squalls is maximum in pre-monsoon season (March-May) in different parts of the country. However, there is a secondary maximum in the winter season over Northwest India. The intensity of squall is maximum in May followed by April.

Dust Storm

Northwest India experiences convective dust storms called "Aandhi" locally during the pre- monsoon season. The frequency of dust storms is maximum over Rajasthan followed by Haryana, Punjab and west UP. The dust storm mainly occurs in the pre-monsoon season and it is maximum in May in terms of frequency and intensity.

3.3.7 Multi-Hazard Vulnerability

A state may be vulnerable to multi-hazards. The natural calamity severity map classifying states on the basis of vulnerability to multiple hazards is shown at **Appendix–VII** & **Appendix–VIII**. The power structures & buildings in areas prone to multi-hazards should be designed after taking into consideration all the hazards.

3.4 Risk Analysis for Electricity Infrastructure

Electricity Infrastructure is dispersed throughout the country and is being severely affected by the natural and humanly induced hazard. Risk analysis of electricity infrastructure to natural hazards has gained even more importance in view of extreme weather events due to climate change.

For estimating threats to the power system infrastructure, fragility and vulnerability analysis is to be carried out for civil structures like buildings, tall structures, foundations in the generation infrastructures, towers, gantry structures, and foundations in transmission and distribution facilities. Accurately

assessing climate risks is difficult because of the uncertainty in predicting the level and timing of climate threats. While uncertainty caused by climate change is unavoidable, electric utilities can manage risks by considering different climate scenarios and potential impacts on their assets, the investment options available and the robustness of the proposed options.

Risk assessment of electric power generation stations, transmission, distribution and Grid Operations (NLDC/RLDCs/SLDCs) infrastructure is an important step in ensuring reliable power supply and quick restoration even in times of extreme weather events and natural disasters. Aim of such analysis is to evolve methods for finding quantitative risk involved in power wheeling networks to devise effective strategies for prevention, mitigation, response, and recovery. Risk analysis involves vulnerability assessment of the electrical establishments including its equipment and hazard assessment of the site/region of interest. This will be helpful for policy and decision-makers to evaluate strategies and measures for critical infrastructure planning and protection.

Technically, a vulnerability assessment can be done through the following steps:

- Defining system with elements or element set.
- Identifying the hazards and threats to the element.
- Modeling hazard environments and fixing the damage scale to measure the adverse consequences.
- Analyze the element for similar hazard environment (mostly simulated) using technical tools.
- Post-process the amount of damage in analyzed element with respect to pre-defined damage scale.
- Declare element's risk as a fragility/vulnerability function with intensity of hazard considered and
- updating the same.

Box-3.1: Hazards that may pose disaster risks in the power sector:

- Fire / Forest fire
- Cyclones
- Floods/cloud burst/urban flood
- Earthquakes
- Tsunamis
- Landslides
- Thunderstorm & Lightning, Squall, Dust Storm, and Strong Wind
- Pandemic/Epidemic
- Environment and Climate Change

Box-3.2: Disaster Zoning:

- The concept of disaster zoning identifies the areas having similar parameters on average particularly with respect to disaster caused by natural hazard.
- Natural calamities like earthquakes, cyclones /cyclonic storm /hurricanes, floods, tsunamis etc. have been scientifically and statistically studied based on data collected the world over.
- It has become possible to predict their intensities with a certain degree of confidence so that structures / equipment / machinery etc. can be designed to withstand the effect of these forces.

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Chapter-4

4. Coherence of Disaster Risk Management across Resilient Development and Climate Change Action

The three landmark global agreements reached in 2015 – Sendai Framework for Disaster Risk Reduction (Sendai, Japan, March 2015), Sustainable Development Goals (UN General Assembly, New York, September 2015) and Climate Change Agreement (COP21, Paris, December 2015) set the stage for future global actions on DRR, sustainable development and climate change. These frameworks, taken together, represent a nearly complete agenda for building disaster resilience.

Along with the mandate given in DM Act 2005 and NPDM 2009, the disaster management plan of the power sector is now aligned with the global trends and priorities set in these three major post- 2015 global frameworks documents in the domains of DRR, sustainable development and the responses to meet challenges of global climate change and also with PM's Ten Point Agenda.

4.1 Sendai Framework for Disaster Risk Reduction

The emphasis of Sendai Framework is on preventing new and reducing existing disaster risks and strengthening overall disaster resilience through the implementation of integrated measures. In addition, the scope of DRR has been broadened significantly to focus on both natural and human-induced hazards including various related environmental, technological and biological hazards and risks. The framework acknowledges the interlinkages between climate change and disaster risks.

The salient features of Sendai Frameworks are:

1) Outcome - To achieve substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries globally over a span of 15 years i.e. by 2030.
2) Goal - Prevent new and reduce existing disaster risks through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.
3) Four Priorities - The four priorities for action are:
    i. Understanding disaster risk

ii. Strengthening disaster risk governance to manage disaster risk
iii. Investing in disaster risk reduction for resilience &
iv. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

4) Seven Targets –
   i. Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rates in the decade 2020–2030 compared to the period 2005– 2015;
   ii. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015;
   iii. Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030;
   iv. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;
   v. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
   vi. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030;
   vii. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

Figure-4.1: Sendai Framework for Disaster Risk Reduction - 7 Global Targets

5) Major departures in Approach - There are some major departures from the earlier disaster management approach in the Sendai Framework:
   - For the first time, goals are defined in terms of outcome-based targets instead of focusing on sets of activities and actions.
   - It places governments at the center of disaster risk reduction with the framework emphasizing need to strengthen disaster risk governance.
   - There is a significant shift from earlier emphasis on disaster management to addressing disaster risk management itself by focusing on the underlying drivers of risk.
   - It places almost equal importance on all kinds of disasters and not only on those arising from natural hazards. In addition to social vulnerability, it pays considerable attention to environmental aspects through a strong recognition that the implementation of integrated environmental and natural resource management approaches is needed for disaster reduction.
   - Disaster risk reduction, more than before, is seen as a policy concern that cuts across many sectors, including health and education.

India is a signatory to the Sendai Framework for a 15-year, voluntary, non-binding agreement that recognizes that the State has the primary role to reduce disaster risk, but that responsibility should be shared with other stakeholders including local government, private sector and other stakeholders. India will make its contribution to achieve the seven global targets set by the Sendai Framework.

4.1.1 Conformity of Plan with Sendai Framework

For each hazard, the approach used in this plan incorporates the four priorities enunciated in the Sendai Framework into the planning framework for Disaster Risk Reduction under the six Thematic Areas for Action:

i. Understanding Risk
ii. Inter-Agency Coordination
iii. Investing in DRR – Structural Measures
iv. Investing in DRR – Non-Structural Measures
v. Capacity Development
vi. Climate Change Risk Management

For each thematic area for action, the plan has identified a set of major sub-themes for undertaking actions within the broad planning framework (Chapter 7: Disaster Risk Reduction and Building resilience – The Responsibility Matrix). For each hazard, themes for action are presented in a separate responsibility matrix assigning roles of centre and state for each of the thematic areas for action. The activities envisaged fall into short/ immediate (within 5 years), medium (within 10 years), and long-term (within 15 years) categories, which will be implemented in

many instances concurrently, and not necessarily sequentially. Some of the actions under immediate response are short-lived, while many of the measures for risk reduction and strengthening resilience are long term, which becomes part of all facets of the developmental process through mainstreaming.

4.2 Sustainable Development Goals (SDG)

The Sustainable Development Goals (SDGs), adopted by the UN General Assembly on 25 September 2015, consisting of 17 Global Goals and 169 targets, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. It includes new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities.

Figure-4.2: Sustainable Development Goals (SDGs) adopted by the UN

4.2.1 Sustainable Development Goals (SDG) and Disaster Resilience

Sustainable development (SD) and disaster risk reduction (DRR) are closely interlinked. A single major disaster or "shock" incident (i.e. a rapid onset disaster like an earthquake, storm, tsunami or landslide) can undo hard-won development progress and set back development by years. A "stress" incident (i.e. a slow onset disaster like drought, sea level rise, and salinity intrusion into groundwater stocks) can also cause long-term socio-economic harm. Climate change aggravates impacts from both natural hazards and human-induced vulnerabilities by acting as a threat multiplier. Driven by climate change, there is an increase in the frequency and

severity of extreme weather events (including storms, droughts, heat waves and cold "snaps") associated with climate change. Such events multiply the risks that people living in areas prone to natural hazards already face.

The possibilities of attaining SDGs are jeopardized because disasters undermine economic growth and social progress. The vision set out in the SDGs – for people, planet, prosperity and peace – will inevitably fail if shocks and stresses are not addressed. Progress in implementing the Sendai Framework contributes to the progress of attaining SDGs. In turn, the progress on the SDGs helps to substantially build resilience to disasters. There are several targets across the 17 SDGs that are related to DRR. Conversely, all seven global DRR targets of the Sendai Framework are critical for the achievement of the SDGs.

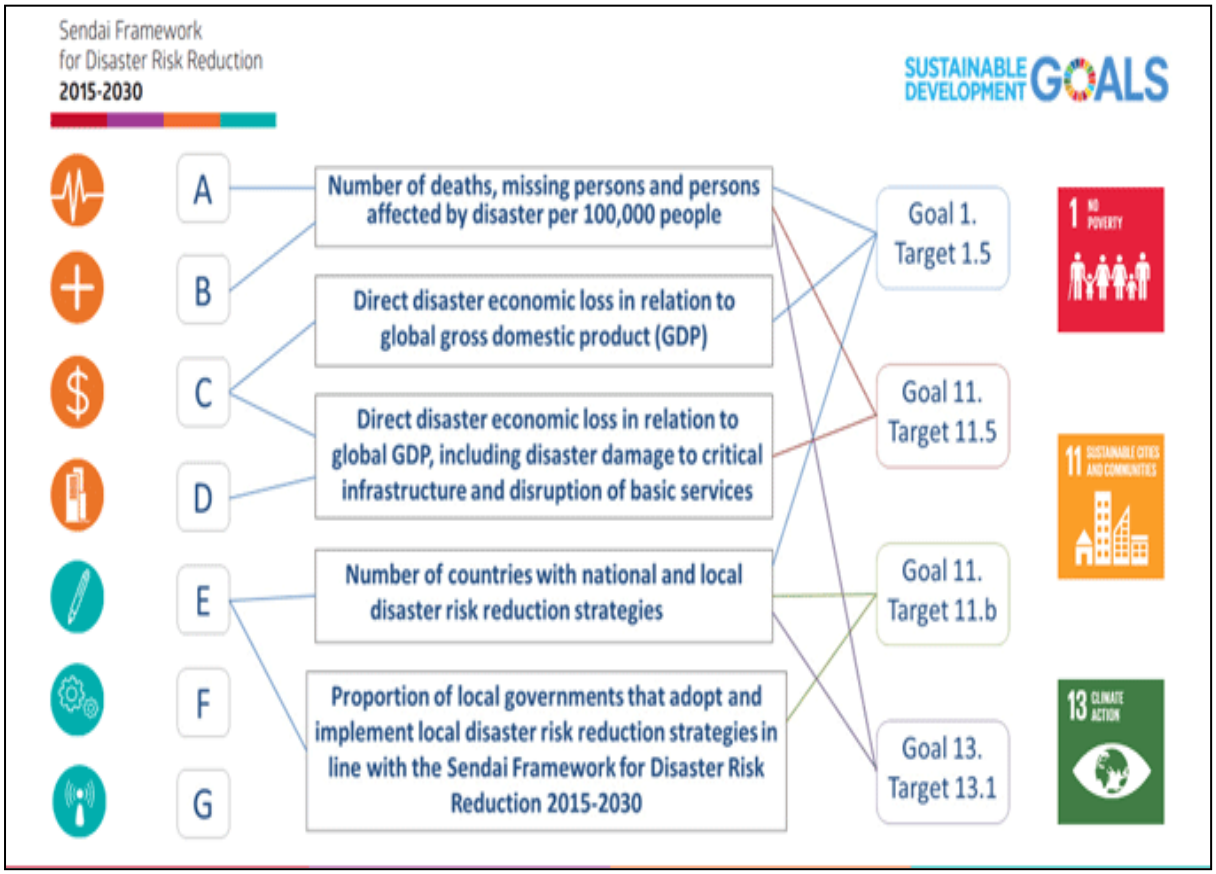

Figure-4.3: Coherence and mutual reinforcement of SDGs and Sendai Framework

4.2.2 Conformity of the plan with Sustainable Development Goals (SDG)

The electricity sector is related to almost all of the sustainable goals explicitly or implicitly and any disruption in power supply in the wake of any disaster may derail the process of development and affects achievement of identified goals such as no poverty, no hunger, affordable and clean energy, decent work and economic growth, sustainable cities and communities etc. The plan covering disaster risk reductions, building resilience, preparedness, response and recovery – all are essentials for achieving sustainable development goals. The plan also addresses

issues of gender equality (In the Capacity Building Framework discussed under Chapter 7 i.e. Disaster Risk Reduction and Building resilience – The Responsibility Matrix) and Climate related measures (Chapter 6: Disaster Risk Reduction and Building resilience). Climate Change Risk Management has also been discussed for each type of hazard in the Responsibility matrix discussed in Chapter 7.

4.3 COP21 Agreement, Paris, on Climate Change Action

The Paris Agreement was adopted on 12 December 2015 at the Twenty-first session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCC) that brings together all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects. It aims at "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change". It aims at undertaking rapid reductions of emissions in accordance with the best available science.

4.3.1 COP21 Agreement and Disaster Risk Reduction

There is a significant convergence between the problems that disaster risk reduction and climate change adaptation seek to address (Figure-4.4). The regions already exposed to climate-related hazards and effects will be at greater risk due to a projected increase in the frequency and/or intensity of those hazards and effects because of global climate change.

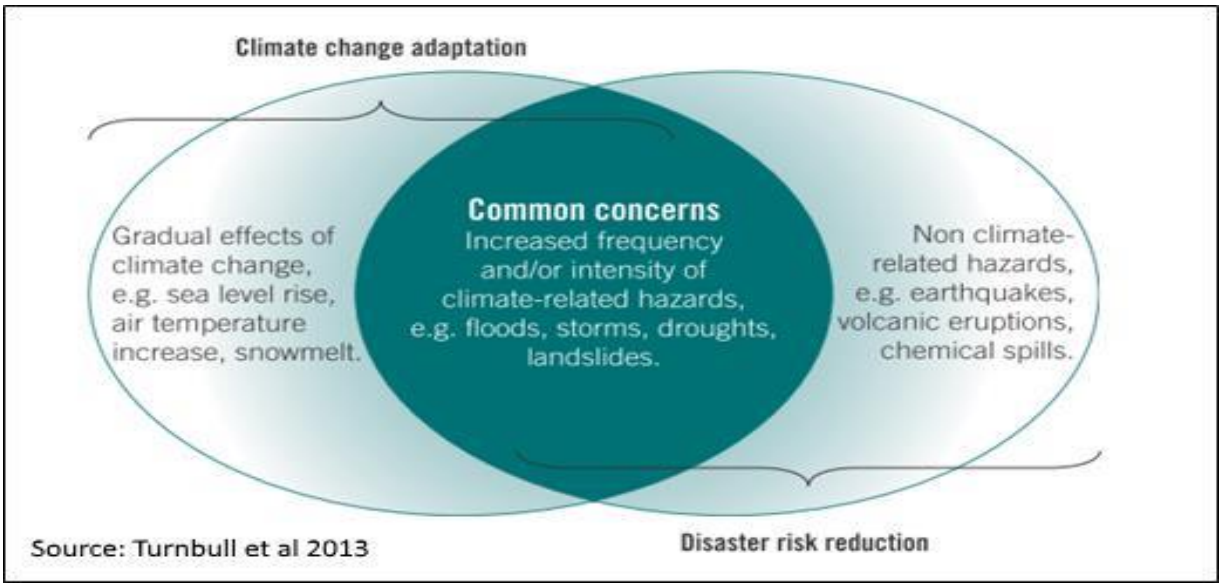

Figure 4.4: Common concerns of climate change adaptation and disaster risk reduction

4.3.2 Conformity of the plan with COP21 Agreement

The power sector has also contributed adversely to environment and climate change phenomena as generation of electricity by thermal power plants is one of the main sources of CO_2 emissions in India. The strategies for reducing the adverse effects are discussed under Chapter 6 "Disaster Risk Reduction and Building resilience" that suggests action such as adoption of carbon capture and storage (CCS), improving energy efficiency, switching to lower-carbon fuels (e.g. from coal to gas). The GoI has targeted to achieve 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 that is expected to contribute immensely in reducing carbon emissions thereby achieving the target set in COP 21 agreement. Also, Climate Change Risk Management has been discussed for each type of hazard in the Responsibility matrix discussed in Chapter 7 viz. Disaster Risk Reduction and Building resilience – The Responsibility Matrix.

4.4 Coherence and Mutual Reinforcement for DRR

In view of changes in human demographics and trends in development, impact of climate change (which disproportionately affects the poorest and most vulnerable people), and increasing exposure to disaster risks, there has never been a greater need to enhance coherence and coordination among all the major global initiatives to reduce risks, vulnerability to hazards and enhance resilience. Taken together, the different priorities, targets and actions in the three frameworks constitute a more comprehensive resilience agenda than when implemented independently, without mutual reinforcement, because building resilience requires action that spans multiple domains of development, humanitarian initiatives, responding to climate change and disaster risk reduction. Given the complementarities among them, synchronising and mutually reinforcing actions in the three domains help in better outcomes. Efforts must be made to ensure that each of them does not build in "policy risks" or, contradictory policies, that generate more - rather than less - risk in development.

The DMP of power sector has tried to envisage coherence across the national efforts for sustainable development, DRR and actions in response to climate change (mitigation and adaptation). It identifies mutually reinforcing measures in these three domains. The mainstreaming of DRR can be synchronized with the initiatives for sustainable development and the steps taken to address climate change impacts can be included as an inherent part of the development agenda.

Figure-4.5 displays the ideas of coherence and reinforcement across the three frameworks adopted into various National Plans. The ways the coherence and

mutual reinforcement are envisaged for SDGs and Sendai Framework are depicted in Figure-4.6.

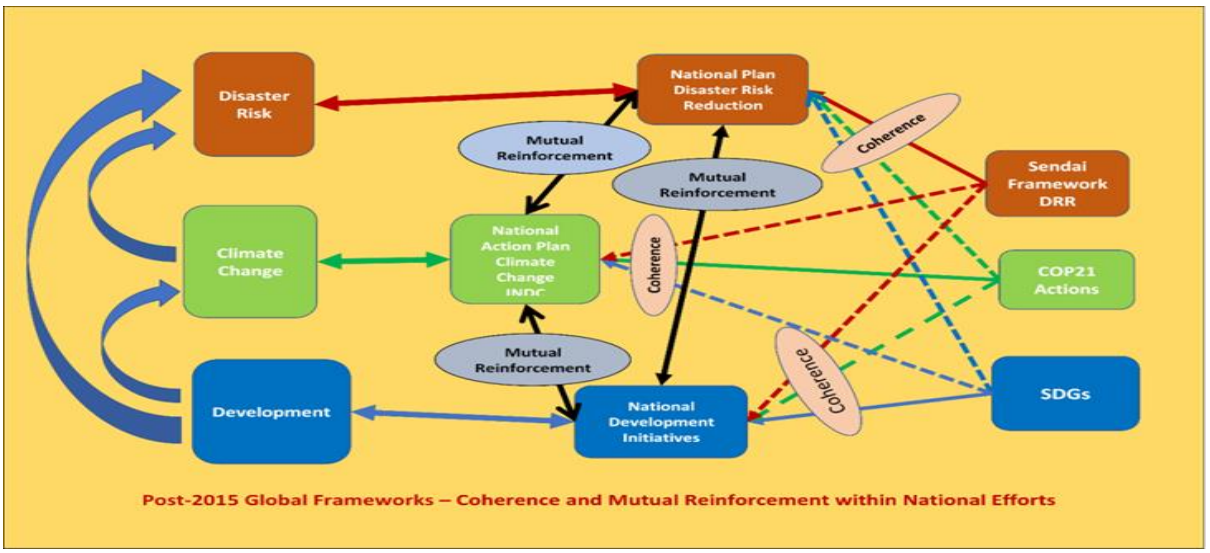

Figure-4.5: Challenges of ensuring coherence and mutual reinforcement of three global frameworks within national initiatives

Figure-4.6: Envisaging coherence and Mutual Reinforcement of SDGs and Sendai Framework

The ways for envisaging coherence and mutual reinforcement of SDGs and COP21 for climate change mitigation are depicted in Figure-4.7.

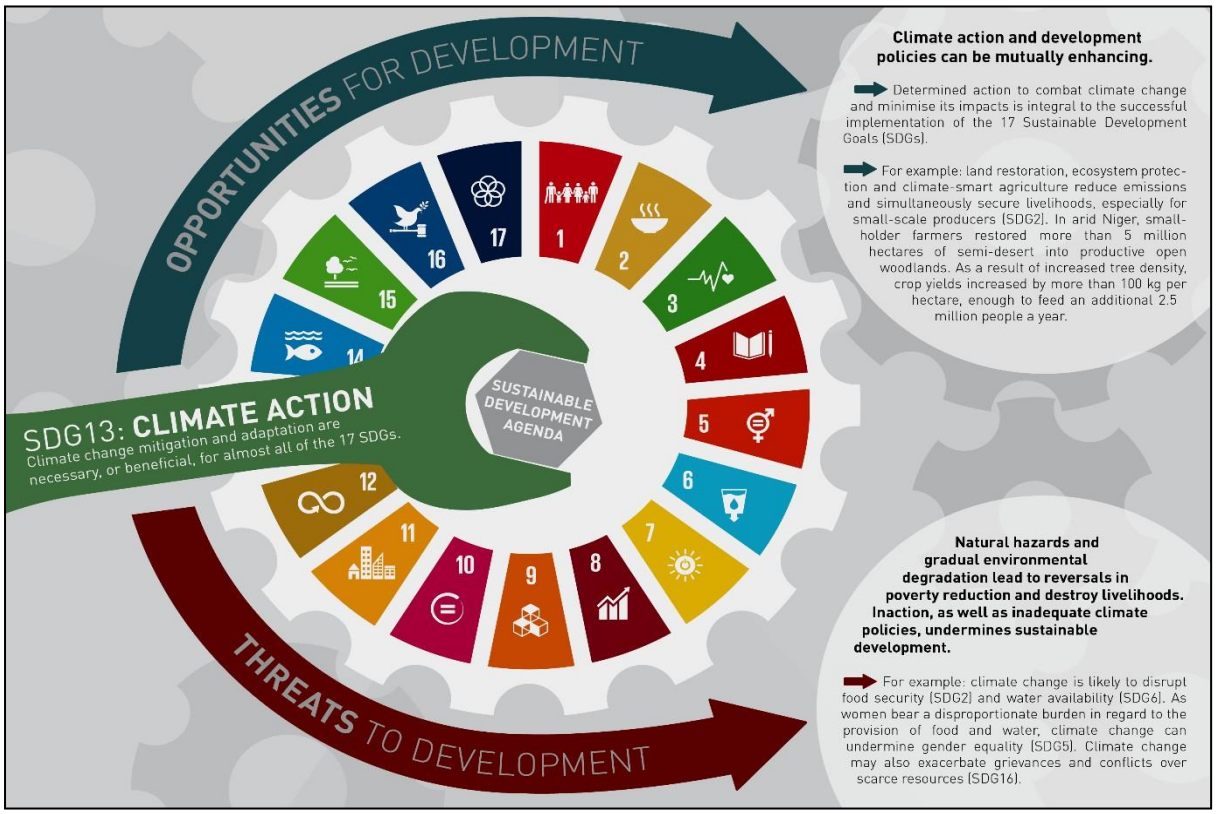

Figure 4.7: Envisaging coherence and mutual reinforcement of SDGs and COP21 for climate change mitigation

The measures envisaged for ensuring coherence and reinforcement are discussed in chapter 5 “Mainstreaming Disaster Risk Reduction into Developmental Plan”. India’s national initiatives relevant for DRR across the three Global Frameworks are summarised in Table-4.1.

Table-4.1: India’s national initiatives relevant for DRR across the three Global Frameworks

Sl. No.	Sendai – Global Targets	SDG	COP21 – Paris Agreement on Climate Change	National Initiatives Relevant to DRR
1	Substantially reduce global disaster mortality by 2030 (2020-2030 compared to 2005-2015)	SDG 1, 2, 11, 13	• Changes in the pattern of extreme events require enhanced disaster resilience and adaptation • Addressing GACC risks is crucial for eliminating poverty and reducing economic losses from disasters	Multiple schemes and initiatives for DRR, economic development, GACC mitigation and adaptation.

Sl. No.	Sendai – Global Targets	SDG	COP21 – Paris Agreement on Climate Change	National Initiatives Relevant to DRR
2	Substantially reduce the number of disaster affected people by 2030 (2020-2030 compared to 2005-2015)	SDG 1, 11, 13	Stresses the need for accelerated action to build resilience through risk-sensitive planning and implementation of DRR	• Allocation of resources and funds for disaster prevention and to develop capacities for DRR • Strengthening of the DRM at all levels • Promoting disaster-resilient development • Mainstreaming DRM and adaptation to GACC in development
3	Substantially reduce direct disaster economic loss	SDG 1, 11	The Paris Agreement aims to hold global average temperature increase to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C, recognizing that this would significantly reduce the risks and impacts of climate change	• National commitment to DRM evident from the PM Ten Point Agenda for DRR • National commitments for mitigation of and adaptation to GACC as per Intended Nationally Determined Contributions (INDC)
4	Substantially reduce damage to critical infrastructure and disruption of basic services (health, education, etc.)	SDG 1, 4, 9, 11,	Global adaptation goals for enhancing adaptive capacity, strengthening resilience and reducing vulnerability to ensure adequate adaptation response in the context of the global temperature goal	Enhance the resilience of national health systems by integrating DRM into primary, secondary and tertiary health care, and by promoting and enhancing training capacities in the field of disaster medicine. The substantial reduction of disaster damage to critical infrastructure and disruption of basic

Sl. No.	Sendai – Global Targets	SDG	COP21 – Paris Agreement on Climate Change	National Initiatives Relevant to DRR
				services is essential to ensure healthy lives and promote wellbeing.
5	Substantially increase disaster risk reduction strategies	SDG 1, 3, 6, 11, 13,	Addressing GACC risks that are crucial for reducing economic losses from disasters along with a well-integrated approach to adaptation, sustainable development, environmental management and disaster risk reduction	• NAPCC for mitigation of and adaptation to GACC • National Mission on Sustainable Agriculture (NMSA) • National Initiative on Climate Resilient Agriculture (NICRA)
6	Substantially increase international cooperation to complement national actions	Close international cooperation to achieve SDGs	Firm commitments by countries to the global response to GACC based on INDCs and international cooperation for achieving the COP21 goals	India as a pro-active member in the implementation of the Post-2015 and other global frameworks
7	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments	SDG 3, 13	Emphasis on improving early warning systems, risk assessment and management	National investments to improve the early warning and information systems in different sectors and for multi-hazards.

For monitoring progress of Sendai Framework, a set of 38 indicators (**Annexure-I**) under its seven targets have been listed that must be measured against the time period of 2005-15, in terms of the percentage change with respect to the baseline. This sectoral segregated baseline data for the period of 2005-15 will be collated by the central Ministry/ Department and States/UTs.

4.5 Prime Minister's Ten-Point Agenda for Disaster Risk Reduction

The Prime Minister has enunciated a Ten-Point Agenda (TPA) in his inaugural speech at the Asian Ministerial Conference on Disaster Risk Reduction 2016, held

in New Delhi during November 2016 (AMCDRR), which has also been incorporated in the NDMP. The ten key elements consist of the following:

Table-4.2: Prime Minister's Ten-Point Agenda for Disaster Risk Reduction

Sl. No.	PM's Ten Point Agenda	Brief Description
1.	All development sectors must imbibe the principles of disaster risk management.	All development sectors must imbibe the principles of disaster risk management. This will ensure that all development projects - airports, roads, canals, hospitals, schools, bridges – are built to appropriate standards and contribute to the resilience of communities they seek to serve. This points to the need for ensuring that all the infrastructure development conforms to the best available standards of disaster safety. Such an approach is a smart strategy, which will pay off in the long term. It is necessary that all public investments must incorporate disaster risk considerations. In India, the 'housing for all' programme and 'smart cities' initiatives represent such opportunities. India will work with other partner countries and stakeholders to build a coalition or mechanism for promoting disaster resilient infrastructure in the region. This will help generate new knowledge for hazard risk assessment, disaster-resilient technologies and mechanisms for integrating risk reduction in infrastructure financing.
2.	Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states.	It is necessary to work towards risk coverage for all – starting from poor households, it must cover small and medium enterprises as well as large multi-national corporations. Currently, in most countries of the region, penetration of insurance is limited to a narrow section only, mostly in the middle and upper-middle income groups. It is necessary to think big and innovatively to widen the risk insurance cover. States have an important role in not just regulating but also encouraging coverage for those who need it the most.
3.	Women's leadership and greater involvement should be central to disaster risk management.	It is necessary to encourage greater involvement and leadership of women in disaster risk management. Women are disproportionately affected by disasters. They also have unique strengths and insights. India must train a large number of women volunteers to support special needs of women affected by disasters. There is also a need for women engineers, masons and building artisans to participate in post-disaster reconstruction and promote women self-help groups which can assist in livelihood recovery.

Sl. No.	PM's Ten Point Agenda	Brief Description
4.	Invest in risk mapping globally to improve global understanding of Nature and disaster risks.	It is necessary to invest in mapping risks globally. For mapping risks related to hazards such as earthquakes, there are widely accepted standards and parameters. Based on these, India has mapped seismic zones, with five as the highest seismic risk and two as low risk. For disaster risk related to other hazards such as chemical hazards, forest fires, cyclones, different types of floods, India needs to adopt globally accepted standards and categories. This will help India to ensure that there is a shared understanding of the nature and severity of disaster risks and compare it with that in other parts of the world.
5.	Leverage technology to enhance the efficiency of disaster risk management efforts.	Efforts must be made to leverage technology to enhance efficiency of our disaster risk management efforts. An e-platform that brings together organizations and individuals and helps them map and exchange expertise, technology and resources would go a long way in maximizing the collective impact.
6.	Develop a network of universities to work on disaster-related issues.	It will be helpful to develop a network of universities to work on disaster-related aspects since universities have social responsibilities too. Over the first five years of the Sendai Framework, an effort can be made to develop a global network of universities working together on problems of disaster risk management. As part of this network, different universities could specialize in multi-disciplinary research on disaster issues most relevant to them. Universities located in coastal areas could specialize in managing risks from coastal hazards, and the ones located in the hill cities could focus on mountain hazards.
7.	Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction.	Utilize the opportunities provided by social media and mobile technologies. Social media is transforming disaster response. It is helping response agencies in quickly organizing themselves and enabling citizens to connect more easily with authorities. In disaster after disaster, affected people are using social media to help each other. Those responsible for disaster management must recognize the potential of social media and develop applications relevant to various aspects of disaster risk management.
8	Build on local capacity and initiative to enhance disaster risk reduction	Disaster management must build on local capabilities and initiatives. The task of disaster risk management, particularly in rapidly growing economies, is so huge that formal institutions of the state can at best be instrumental in creating the enabling conditions. Specific actions have to be designed and implemented locally. Over the last two

Sl. No.	PM's Ten Point Agenda	Brief Description
		decades, most community-based efforts have been confined to disaster preparedness and contingency planning for the short term. It is necessary to expand the scope of community-based efforts and support communities to identify local risk reduction measures and implement them. Such efforts reduce risk and create opportunities for local development and sustainable livelihoods. Localization of disaster risk reduction will also ensure that good use is made of the traditional best practices and indigenous knowledge. Response agencies need to interact with their communities and make them familiar with the essential drill of disaster response. For example, if a local fire service visits one school in its area every week, it would sensitize thousands of children over a period of one year.
9	Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster	Ensure that the opportunity to learn from a disaster is not wasted. After every disaster there are studies and reports on lessons learned that are rarely applied. Often the same mistakes are repeated. It is necessary to have a vibrant and visual system of learning. The United Nations could start an international competition of documentary films that record disaster events, their scale, and relief, rehabilitation, reconstruction and recovery afterward. Post-disaster recovery is an opportunity to not just 'build back better' in terms of physical infrastructure, but also in terms of improved institutional systems for managing risk. For this, it is necessary to put in place systems that can quickly provide risk assessments. India must work with partner countries and multilateral development agencies to establish a facility for technical support to post-disaster reconstruction of houses.
10	Bring about greater cohesion in international response to disasters	It is necessary to bring about greater cohesion in international response to disasters. In the aftermath of a disaster, disaster responders pour in from all over the world. This collective strength and solidarity could be enhanced further if activities are organised under a common umbrella. The United Nations could think of a common logo and branding under which all those who are helping with relief, rehabilitation and reconstruction operate.

4.5.1 Conformity of the plan with PM's Ten Point Agenda

Table-4.3: Conformity of the plan with PM's Ten Point Agenda

Sl. No.	PM's Ten Point Agenda	Conformity of the plan
1.	All development sectors must imbibe the principles of disaster risk management.	The plan has been prepared on the principles of disaster risk management envisaged under Sendai framework covering all four cycles of disaster management.
2.	Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states.	The plan recommends insurance coverage of all power establishments and its employee under Chapter 11 "Financial Arrangements".
3.	Women's leadership and greater involvement should be central to disaster risk management.	The Responsibility Matrix of Capacity Development under Chapter 7 i.e. "Disaster Risk Reduction and Building Resilience – The Responsivity Framework" recommends for incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management.
4.	Invest in risk mapping globally to improve global understanding of Nature and disaster risks	The hazard mapping of each type of disaster relevant to power sector is discussed in Chapter 3 viz. "Hazard Risk and Vulnerability Analysis". Also, the responsibility for risk mapping for each type of hazard is discussed in the responsibility matrix shown under the "Disaster Risk Reduction and Building Resilience – The Responsivity Framework" (Chapter 7).
5.	Leverage technology to enhance the efficiency of disaster risk management efforts	The plan emphasises the use of technology to enhance the efficiency of disaster risk management efforts in all the stages of disaster management cycle. It recommends for adopting several new technologies for addressing challenges posed by the environment and climate change under the Chapter "Disaster Risk Reduction and Building Resilience" (Chapter 6). It recommends usage of new technologies for disaster risk reduction specific to particular disaster also. For example, DAM bust Computer Simulation Study is recommended for Dams in case of flooding. Similarly, under the Preparedness and Response", new means for quick grid restoration such as ERS & Mobile Substation are recommended. NLDC, Grid – India that

Sl. No.	PM's Ten Point Agenda	Conformity of the plan
		has been designated as the control room for disaster related activities at the national level is entrusted with the responsibility of creating "Weather Portal of Power Sector" for collating information from various sources and issuing advisories to the concerned Utilities in case of an anticipated disaster affecting power system for secure and reliable operation of the Grid. The plan also recommends for creating e-portal for managing & sharing inventory of spare/restoration equipment required during an eventuality to reduce overall response time for restoration under chapter 8 "Preparedness and Response".
6.	Develop a network of universities to work on disaster-related issues	The plan envisages short-term courses on different aspects of Disaster Risk Reduction for power utilities by CEA/NPTI/CPRI under the Chapter "Disaster Risk Reduction and Building Resilience – The Responsivity Framework" (Chapter 7) that could become a part of curriculum for the universities also.
7.	Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction	The role of Social Media for creating awareness and disseminating information for disaster risk reduction and also in post disaster response are discussed under Chapter 8 "Preparedness and Response".
8	Build on local capacity and initiative to enhance disaster risk reduction	The Responsibility Matrix under the Chapter "Disaster Risk Reduction and Building Resilience – The Responsivity Framework" (Chapter 7) recommends various specific action plans for designing and implementing disaster management on local capabilities. It also recommends for building local community capacity for disaster preparedness and contingency planning. The Chapter on "Disaster Risk Reduction and Building Resilience" (Chapter 6) discusses using traditional best practices and indigenous knowledge with respect to landslides specifically. It recommends for identifying and train local groups to discern early warning signs, gather information and dissemination to the appropriate O&M Cell.
9	Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the	Chapter No. 9 "Recovery & Build Back Better" covers this aspect in detail.

Sl. No.	PM's Ten Point Agenda	Conformity of the plan
	lessons after every disaster.	

Box-4.1: The three landmark global agreements reached in 2015:

- The three landmark global agreements reached in 2015 – the Sendai Framework for Disaster Risk Reduction (Sendai, Japan, March 2015), Sustainable Development Goals (UN General Assembly, New York, September 2015) and Climate Change Agreement (COP21, Paris, December 2015) set the stage for future global actions on DRR, sustainable development and climate change.
- These frameworks, taken together, represent a nearly complete agenda for building disaster resilience.

Box-4.2: The four priorities areas of Sendai framework:

- Understanding disaster risk.
- Strengthening disaster risk governance to manage disaster risk.
- Investing in disaster risk reduction for resilience.
- Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Box-4.3: Sustainable Development Goals (SDG):

- The Sustainable Development Goals (SDGs), adopted by the UN General Assembly on 25 September 2015, consisting of 17 Global Goals and 169 targets.
- It is a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.
- It includes new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities.

Box-4.4: COP21 Agreement, Paris, on Climate Change Action:

- Adopted on 12 December 2015 at the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCC).
- It brings together all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.
- It aims at holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

Box-4.5: Prime Minister's Ten-Point Agenda for Disaster Risk Reduction:

1. All development sectors must imbibe the principles of disaster risk management.
2. Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states.
3. Women's leadership and greater involvement should be central to disaster risk management.
4. Invest in risk mapping globally to improve global understanding of Nature and disaster risks.
5. Leverage technology to enhance the efficiency of disaster risk management efforts.
6. Develop a network of universities to work on disaster-related issues.
7. Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction.
8. Build on local capacity and initiative to enhance disaster risk reduction.
9. Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster.
10. Bring about greater cohesion in international response to disasters.

Box-4.6: The Plan Conformity with global frameworks & PM ten-point agenda:

- Along with the mandate given in the DM Act 2005 and the NPDM 2009, the disaster management plan of the power sector is now aligned with the global trends and priorities set in in these three major post- 2015 global frameworks documents in the domains of DRR, sustainable development and the responses to meet challenges of global climate change and also with PM's Ten Point Agenda.
- Given the complementarities among all these frameworks, synchronising and mutually reinforcing the actions in the three domains helps in better outcomes. Efforts must be made to ensure that each of them do not build in "policy risks" or, contradictory policies, that generate more - rather than less - risk in development.
- The DMP of power sector envisages coherence across the national efforts for sustainable development, DRR and the actions in response to climate change (mitigation and adaptation) and identifies mutually reinforcing measures in these three domains.
- The mainstreaming of DRR can be synchronized with the initiatives for sustainable development and the steps taken to addresses climate change impacts can be included as an inherent part of the development agenda.

Chapter-5

5. Mainstreaming Disaster Risk Reduction into Developmental Plan

Disasters have an enormous adverse impact on development. Not only it sets back development process and suddenly reverse decades or more of accumulated developmental gains by damaging the key establishments instrumental for development, but the resources that are planned for further development are often diverted for the recovery process. The impact can be minimised or reduced significantly if adequate risk reduction measures had been incorporated into the development. Also, the development process itself creates disaster risks if not implemented appropriately and disaster risk reduction considerations have not been taken into account in designing the development activities. It warrants that the development activity and disaster risk reduction should be dealt with in unison with all relevant policies, planning and implementation. Such an approach, which internalises DRR within development in a closely integrated manner is called mainstreaming DRM. It means radically expanding and enhancing DRM so that it becomes normal practice, fully institutionalised within each agency's regular planning and programmes in addition to the preparedness for disaster response.

According to UNDRR,

> "M*ainstreaming disaster management into the development planning process essentially means looking critically at each programme, activity and project that is being planned, not only from the perspective of reducing the existing risks disaster disasters, but also from the perspective of minimizing its potential contribution to creation of new risks of disasters".*

Disaster risk reduction can be mainstreamed into development frameworks in various ways and at different levels - spanning the legislative, institutional, sectoral strategies and financial planning. Development does not necessarily reduce disaster risk. It can unwittingly create new risks or exacerbate the existing ones, with disasters likely to be both a cause and a product of development. The recognition of close linkages between development, disaster risk reduction and global climate change has resulted in all the major global frameworks having a shared emphasis on building resilience. Mainstreaming of DRR is the extensive and sound integration of DRR into all developmental initiatives to enhance disaster resilience, reduce losses and hasten progress toward development goals.

5.1 Key Thematic Areas for Mainstreaming

The key thematic areas for mainstreaming DRR and creating enabling environment for it emerging from the global discussions are:

1. Improving awareness and understanding of disaster risk - The DRM policies and practices must be based on improved understanding of disaster risk in all its dimensions and communities be made aware of various aspects of disaster risk so that they are able to proactively take preventive measures. Such awareness is most critically essential on the part of key line agencies, local authorities and communities in high-risk areas.

2. Enhanced legal support and better disaster governance - Adequate and appropriate legislative arrangements for disaster risk management, including mainstreaming of DRR into development, form a key component of an enabling environment. It implies integration of DRR into all the norms, regulations, approval and monitoring relating to development through periodic reviews and amendments.

3. Effective disaster risk management strategy - A comprehensive disaster risk management strategy, actively involving stake-holders at all levels of government as well as the private sector, local communities and civil society, is required to implement the legislative framework and to provide coordination and monitoring mechanisms and arrangements.

4. Ensuring social inclusiveness in disaster risk management - Social inclusion like equality of rights, equal opportunities and dignity of the individual irrespective of social background, community, age, gender or disability is also a cross cutting theme that needs to be an integral part of the mainstreaming efforts.

5. Enabling coherence and mutual reinforcement of initiatives under the major global frameworks for enhancing disaster resilience - There is significant potential for designing financing mechanisms, policies and programmes that can deliver on more than one set of targets of the major global frameworks. Therefore, efforts should be made to achieve national goals under different major global frameworks in which measures taken under one framework strengthen goals in all three frameworks.

6. Institutional arrangements and capacity development (institutional, human, community, technology, etc.) for DRM - DRR is a cross-cutting responsibility that needs to be 'owned' by all government agencies rather than by a single nodal department or agency designated for DRM. The nodal agencies at the national and state levels must provide leadership, determine broad disaster risk management policies, oversee implementation and advocate for the inclusion of disaster risk reduction concerns in broader development. Capacity development shall cover all aspects such as institutional, human, community and technology applications.

7. Intra-government horizontal and vertical integration - Since there are multiple line agencies, sectors and levels of administration involved in development initiatives at national and state levels, mechanisms of inter-agency coordination and integration must be strengthened to ensure that locally identified needs are reflected in higher-level plans and strategies.

8. Budget allocations for integrating DRR concerns into development programs - The mainstreaming of DRR requires each ministry, department and state/UT to make adequate provision for DRR as an integral part of the main budget by ensuring that all the major activities have incorporated DRR.

9. Changes in project appraisal - DRR consideration (e.g., adequately factoring in seismicity, properly estimating flooding probabilities, ensuring restrictions against urban sprawl into industrial hazard-prone areas, strengthening land-use regulations by incorporating hazard risk adequately) must be an integral part of the appraisal processes of various development projects.

10. Setting targets, timeframes, indicators and monitoring mechanisms - It is necessary to set targets to achieve DRR outcomes along with appropriate timeframes, responsibility frameworks and measurable indicators. It can be proceeded in a phased manner with the initial phase focussing on how to incorporate it into overall plans, followed by setting medium and long-term goals.

These broad themes need to be incorporated into policies, plans and programs of all agencies as an integral part of the general plans.

5.2 Implementation

The following are suggested for implementation of mainstreaming disaster risk reduction into developmental plans:

a) Preparation of a guideline explaining the concepts of hazards, vulnerabilities, exposures, capacities, disaster risks, disaster risk management, disaster risk reduction, and mainstreaming disaster risk reduction.

b) The plan of development programme/project should clearly identify and assess the associated risks of existing disasters. All developmental projects plan should invariably include a distinct section clearly indicating the vulnerability of the projects towards any disaster and measures considered for reducing the associated risk.

c) The existing development programme/project should also be reviewed to include DRR to the extent possible cost effectively within their main budget and ensure comprehensive appraisal of all new initiatives (policies, plans, programmes, projects, etc.).

d) The plan should also examine new disaster risks that might be created because of developmental programmes/projects.

e) The climate change impacts act as risk multipliers worsening uncertainties associated with almost every hydro-meteorological hazard. Therefore, all development initiatives must factor in the likelihood of greater risks and increase in climate change-induced vulnerabilities.

f) The plan should examine existing institutional and community capacities to manage the risks of disasters.

g) The plan should include both quantitative and qualitative impact analysis of the disaster.

In brief, the plan for any developmental project/program should be designed to include inbuilt risk management approach. It should not only identify, assess, and analyse the risks associated with it, but should also have a risk management plan that includes measures for risk reduction, preparedness for response and recovery, training and capacity development and institutional and operational systems and processes for risk management. This should be a normal practice, fully institutionalised within each agency's regular planning and programmes.

Box-5.1: Mainstreaming Disaster Risk Reduction into Development:

- The development activity and disaster risk reduction should be dealt in unison with all the relevant policies, planning and implementation. Such an approach, which internalises DRR within development in a closely integrated manner is called mainstreaming DRM.
- The disaster risk reduction can be mainstreamed into development frameworks in various ways and at different levels - spanning the legislative, institutional, sectoral strategies and financial planning.

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Chapter-6

6. Disaster Risk Reduction and Building resilience

As per UNDRR, *Disaster risk reduction consists of a framework of elements aimed at preventing new and reducing existing disaster risk (i.e. disaster mitigation) and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.* Disaster risk reduction includes disciplines like disaster management, disaster mitigation and disaster preparedness. Disaster Specific Mitigation Strategies & measures for building resilience for the Power Sector are suggested in the succeeding paragraphs.

6.1 Disaster Specific Mitigation Strategies for the Power Sector

The power utilities should follow CEA (Safety Requirement for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations to avert or minimize damages that may be caused by any disaster situation.

6.1.1 Fire / Forest fire

The most common cause of fires is known to be electrical short circuits and fire triggered by inflammable materials. The damages caused by fire accidents generally take excessive time for restoration. The consequent loss in electricity generation adds to the miseries. Analysis of causes of fire incidents reveals that the majority of the fires could perhaps be prevented and extent of damage minimized, if fire safety measures were strictly enforced. Notwithstanding this, fire incidents do take place. The success of fire safety measures lies in minimizing the damages and early restoration of the plants and equipment. Early detection of fire and swiftness in firefighting can definitely turn major disasters into minor accidents. The following measures are suggested to reduce the fire risks in power establishments:

a) Fire safety measures should be adopted right at the design stage.
b) Proper upkeep of fire protection equipment/ systems so that timely availability of the system could be ensured for putting out fire before it could result in a crisis situation.
c) The crisis on account of fire could be greatly averted or reduced by adopting modern and state of the art technology for fire detection and monitoring system.
d) Though fire can occur in any part of the establishment, some areas are more prone to fire than others. The fire prone areas must be identified well in advance so that action may be initiated to take precautionary measures.

e) Ban on entry of matchboxes, lighters and other inflammable items into installations handling oil/gas.
f) Provision for smoke and heat sensors and other modern electronic aids in sensitive and fire prone areas.
g) A ready assessment of fire equipment available within the installation as well as within the adjoining areas should be available.
h) In case fire protection equipment is outside the installation, the method of accessing them should also be known to the concerned people. In certain cases, mutual assistance agreement needs to be entered with nearby organizations to share the fire-fighting equipment.
i) The method of handling various types of fire with different types of extinguishing equipment may be listed in order to avoid confusion or any other type of hazards.
j) Periodically checking, testing, maintenance etc. of all equipment and regular checking of Protection & Control Instruments as per the Manufacturer's specification as preventive maintenance.
k) Installation of additional hose pipes and nozzles in different locations.
l) Installation of Emulsifier system in Switchyard.
m) Provision of DG set of required capacity at each power station.
n) Provision of required no of De-watering pumps at each power station.
o) Adequate quantity of Petroleum, Oil & Lubricants (POL) in stock for DG Sets.

6.1.2 Cyclone

The following mitigation strategies could be helpful in avoiding disaster due to cyclones in the power sector:

a) The power plant structures should be designed taking into account the wind loads and its effect on the structures as per the IS 875 Part-III Code. Wind design parameters have been averaged over a relatively long period of time (i.e. 1.0-minute wind to 1.0-hour wind) and require a gust factor greater than 1.0 to be applied for the design of structures, systems, or components (SSC). More recently, the fastest 3-second duration gust wind is being defined for SSC design purposes (incorporated in IS 875).
b) In case of very tall structures like chimneys and natural drought cooling towers, model studies in wind tunnels must also be invariably carried out to minimize the possibility of any damage to these tower structures under maximum wind conditions of the concerned zones as per IS 875 Part III.
c) In order to mitigate the effects of increased wind speeds on power transmission due to changes in climatic patterns, technologies like Cables, Utility tunnels, Gas Insulated Lines (GIL) & HVDC ELPIPES to be explored.
d) As far as possible, the existing overhead distribution system should be replaced with the underground cable system in cyclone-prone areas. Where

underground system cannot be adopted, bare overhead conductors should be converted to ABC cables.

e) The reduction of tower span, use of different materials for tower structure for the affected lines and use of k4 factor (as per IS 875) could be considered in the design of transmission towers for cyclone prone areas.
f) Additional towers/poles can be provided in existing lines to reduce the span and normal design spans of 132 kV & 220 kV can be reduced (from 320m to 250m) for transmission lines in coastal areas.
g) As tall towers are more susceptible to failure due to high intensity winds, use of smaller/ lower height towers should be preferred in coastal regions.
h) High Tension Low Sag (HTLS) & high ampacity conductors can be used in the coastal areas as low sag of these conductors for same ampacity will result in lower height of transmission towers.
i) For flooding during cyclones, which causes submerging of transmission tower foundations and tower legs, measures like increasing concrete level from ground level (from 225 mm to 500 mm), use of anti-corrosion paints, use of raised chimneys, use of M30 type concrete and epoxy coated resins for reinforcement in foundations etc. could be adopted.

Also, the "Report of task force on cyclone resilient robust electricity transmission and distribution infrastructure in the Coastal areas" prepared by CEA recommends various preventive & mitigation measures for minimizing the damages to T&D infrastructures in the event of cyclones that should be followed.

6.1.3 Flood/Cloud Burst/Urban Flood

There has been a number of incidences of flooding of hydro power stations during construction and O&M stages in India. Analysis of these incidents provides very valuable information such as:

- Flooding incidents have occurred more under O&M stage.
- More incidents have happened in power plants having Francis turbines because in such turbines, tail race level is almost at the generator floor level and major part of power house is under water.
- In case of under-construction projects, flood water entered through TRT/Tail pool in most instances.
- Inadequate capacity of drainage & dewatering pumps and improper sealing of Draft Tube (DT) gates were major hindrances in preventing flooding incidents.
- Submergence of drainage and dewatering pump control panels resulting in their unavailability also hindered prevention of flooding incidents.

It is observed that the extent of the damage and rehabilitation period could have been minimized if adequate measures had been taken at design, construction and

during operational stages of the hydro power houses. In some cases, even flooding of power house could have possibly been prevented. The following mitigation strategies for avoiding disaster due to the flooding of power plants are suggested:

a) No power project should be located within the flood zone corresponding to a 100 years' frequency or the maximum observed flood level.
b) The formation level of power plants should be kept at least 1.0 m above any damage due to floods.
c) The drainage system of the thermal power plant should be designed for a 1 in 50-year frequency rainfall event for the power block area and for the main access roads.
d) The substations of transmission & distribution networks should be built on a raised platform above defined flood level and overhead lines should be strengthened.
e) Flood damage can also be prevented by using GIS Substation, saltwater – resistant equipment which is less susceptible to damage resulting from inundation. Floodwalls can be established around the substation, and floating or amphibious concepts could also be potentially used.
f) In case of hydro power projects, particularly located in susceptible cloud burst areas, storage dams should also be constructed in each basin which can mitigate flash floods by storing the sudden flow of water caused by flash floods due to cloud bursts in the reservoir area.
g) Dam Burst computer simulation studies should normally be done to assess impact of the failure of a major dam on the downstream side and for making assessment of the damages likely to occur. Such studies reveal to some accuracy the areas which may get affected in case of a failure of dam and as such, the future development in downstream of the dam can accordingly be regulated so as to minimize the adverse impact of the disaster on account of the failure of the dam.
h) Also, pre- and post-monsoon inspections of dams and reservoirs should invariably be taken and implementation of safety enhancements should be monitored continuously in accordance with norms.

6.1.4 Earthquake

The following mitigation strategies are suggested for avoiding disaster due to the earthquake:

a) Power sector establishments should either be located to avoid high seismic zones or to be designed based on BIS Code to survive the earthquake.
b) IS 1893(Part 1) is related with earthquake resistant buildings whereas IS 1893 (Part 4) deals with earthquake resistant design of industrial structures (plant and auxiliary structures) including stack-like structures such as

transmission, distribution, and communication towers, chimneys and silos. The design approach adopted in this standard is to ensure that structures possess minimum strength to withstand minor earthquakes (as per Design Basis Earthquake), which occur frequently, without damage; resist moderate earthquakes (as per Design Basis Earthquake) without significant structural damage though some non-structural damage may occur, and withstand a major earthquake (as per Maximum Considered Earthquake) without collapse. The power establishments should be designed based on these BIS standards.

c) In existing practice of design of control room, building importance factor of 1.5 is being considered as per IS. It is recommended that for a substation in seismic zone IV & V, higher importance factor of 1.75 shall be considered as per IS.
d) In substation design standards, provisions shall be made to design the interconnecting transformer and its foundation, building and other equipment to withstand the earthquake as per required accelerations.
e) Heavy equipment including transformers are required to be locked with foundations so that during quakes, these equipment must not dislocate from its location.
f) Liquefaction is a phenomenon in which the strength and stiffness of soil are reduced by earthquake shaking or other rapid loading. Liquefaction and related phenomena have been responsible for tremendous amounts of damage in historical earthquakes around the world. While designing foundations of buildings/ structures falling in Seismic Zone IV & V, necessary inputs related to liquefaction have to be considered.
g) In case of Hydro-electric projects especially with large dams, site-specific seismic studies of the project area need to be carried out and design of structures should accordingly be finalized.

6.1.5 Tsunami

The elevation above the tide level (at the time of tsunami) reached by water is called run-up elevation. It varies considerably from point to point along the coast and is very sensitive to the shape of the coastline as it relates to the direction of the source mechanism for wave. Data on run-up elevations for the whole coastline should be collated and used as a reference for designing structures. As far as possible, the existing overhead distribution system should be replaced with underground cable system in tsunami prone areas.

6.1.6 Landslide and Snow Avalanche

The disaster management network has to harness the local knowledge-based warning systems for landslide hazards. The monitoring of hazardous locales by

educated, aware, and sensitized communities is the most valuable and reliable information base for developing an effective early warning system. Local committees or groups have to be identified and trained to discern early warning signs, gather information and disseminate them to appropriate O&M cells.

Avalanche Anti-icing systems to be explored in power lines in hilly areas prone to snowfall. These include anti-icing coatings and other ice phobic materials. De-icing systems can also be explored which reduce deposited ice by thermal/mechanical forces along with monitoring systems. Wherever probability of avalanches exists, avalanche diverters can be constructed so as to divert the avalanches for improving reliability of power lines.

6.1.7 Thunderstorm & Lightning, Squall, Dust Storm & Strong Wind

The following mitigation strategies may be adopted by the power utilities to avoid potential disasters that could be caused by thunderstorm & lightning, squall, dust storm & strong wind:

a) The power plant structures are to be designed taking into account the wind loads and its effect on the structures as per IS 875 Part-III Code. Wind design parameters have been averaged over a relatively long period of time and require a gust factor greater than 1.0 to be applied for design of structure, systems and components.
b) Protection against lightweight panels can be provided by properly securing them with their supporting frames. The connection has to ensure that shearing or punching is avoided. Also, it has to be ensured that panels themselves have requisite strength to withstand wind force.
c) In case of very tall structures like chimneys and natural drought cooling towers, model studies in wind tunnels must also be invariably carried out to minimize the possibility of any damage to these tower structures under extreme wind conditions.
d) For distribution networks, underground or ABC cables may be used in the potential thunderstorm/lightning, Dust/Hailstorm, Squall, and Strong Wind zones as far as possible.
e) For protecting the power establishment against lightning, installation of lightning arrestors and sound earthing for each building is essential. Lightning shields are the most commonly employed structural protection measure for buildings and other structures.

6.1.8 Pandemic / Epidemic

The following mitigation strategies may be adopted by the power utilities against pandemic/epidemic outbreaks:

a) The power infrastructure may be classified, based on the length of time for which they may operate without human intervention.
b) As far as possible, automation of power system operation may be carried out so that manual intervention may be minimized.
c) Modern technology like drones may be used for various operational purposes such as for surveillance, transportation of smaller parts and inspections of generation, transmission and distribution infrastructure.
d) As far as possible, local manufacturing and local supply chain may be promoted.
e) The functions critical to continued operations and people needed to fill those positions should be identified. The activities that can be suspended or postponed during emergencies should also be identified.
f) Availability of fuels, spares and medical supplies must be ensured, at all times, through a critical stockpile. Stockpile should be monitored for expiry and replenishment.
g) The awareness programs should be conducted so that the employees understand their roles and responsibilities during each phase of pandemic response.
h) The pandemic response plans of the power utilities should be prepared in consultation with other critical infrastructure providers such as fuel suppliers, transportation, and emergency services and also with the contractors and suppliers to ensure that these interdependencies are not compromised during a pandemic.
i) Alternative domestic or local suppliers may also be identified to fill in the gap in emergency situations.
j) The policy and preparedness with respect to human and other essential resources, transportation, hygiene and sanitation, medical facilities etc. should be reviewed on a fortnightly basis at least.
k) Personal Protective Equipment (PPE) and additional cleaning supplies needed to support modified cleaning, temporary care, and air-handling procedures should be identified and arranged.

6.1.9 Emerging Issue - Environment and Climate Change

Electricity infrastructures like substations and transmission/distribution lines are designed to operate under differing climatic conditions throughout the year. However, climate change could pose additional challenges yet to be accounted for in current planning and design. For addressing the above challenges, structural aspects of the design of power infrastructure shall incorporate additional safety factors than prescribed in the existing standards and codes. Codes and standards also need to fill the gaps based on dynamic changes occurring due to climate change.

Apart from that, the following strategies should be adopted for addressing challenges posed by environment and climate changes:

a) The transformer/reactors and its foundation, building and other equipment are required to be designed to withstand an earthquake as per required accelerations.
b) Use of cable transit system which prevents any water ingress and provides effective accelerations.
c) Transmission line design standards specify different reliability levels and terrain categories based on the voltage level and configuration. For location which is vulnerable to natural hazard, higher reliability level and different terrain condition may be adopted for improving structural stability.
d) In order to mitigate the effects of increased wind speeds on power transmission due to changes in climatic patterns, technologies like cables, Utility tunnels, Gas-insulated lines (GIL) & HVDC ELPIPES should be explored.
e) Use of composite insulators and silicone coated ceramic insulators in heavily polluted areas along with monitoring systems.
f) Use of lightning location systems to design earthing systems for transmission lines so that the frequency of flashovers in critical lines carrying bulk power is brought to an acceptable level. Lightning Arresters may be used in lightning prone areas to protect the equipment installed at various locations from the damaging effects of lightning.
g) Use of new technology conductors like High-temperature low sag (HTLS) and Thermal ACSR (Aluminium Conductors Steel Reinforced) can be used for distribution lines having Capacity constraints due to thermal loading.
h) Use of Importance Factor higher than Prescribed by the standard while designing Control Room Buildings.

The environment and climate change is a continuous process and its slow pace in comparison to other natural calamities that strike suddenly provides an opportunity to formulate mitigation strategies well ahead in time. Apart from taking regular measures like preventive and condition-based maintenance of electrical assets, there is a need for keeping a close eye on changing climatic patterns and keep on updating monitoring systems, designs and standards of the electrical equipment and hazard zoning on a regular basis and the structures are to be rebuilt or modified accordingly.

Not only environment and climate change have some significant effect on the power sector, but the power sector has also contributed adversely in environmental and climate change phenomena. The measures, which can be adopted to cope with the environment and climate change and to continue in the path of sustainable development of the power sector are as under:

- Adoption of carbon capture and storage (CCS) for fossil fuel plants can reduce emissions. CO_2 storage capacity is large and all parts of the technology have been demonstrated. CCS units burning bioenergy (BECCS) can draw CO_2 from the air. However, barriers to CCS and BECCS remain, including cost.
- Energy efficiency can be improved by retrofitting existing plants and adopting efficient new ones;
- Reducing transmission and distribution losses and through technology improvements in fossil fuel extraction and conversion.
- Switching to lower-carbon fuels (e.g. from coal to gas) can reduce emissions. Moving from the world-average efficiency coal plant to state-of-the-art gas can halve emissions if fugitive methane release is controlled, and can act as a 'bridging technology.
- Increasing more contribution of renewables in the energy mix.

6.2 General Recommendations for Building Resilience

Apart from various disaster risk reduction strategies discussed above, some other measures for bringing resiliency in the system are described below:

a) Planning buildings, foundations, chimneys, towers, poles and structures with next-generation materials like hollow carbon fibre reinforced alloys, high ductile strength steel (Fe-500 D) etc.
b) For generating station - Higher plinth in flood-prone areas, strengthened building, use of composite materials etc.
c) For transmission systems - Construction of building, substations on a raised platform, upgrading aluminium structures to galvanized steel, lattice or concrete.
d) For distribution systems - Upgrading concrete poles to steel, or a composite material, and installing support wires and other structural supports.
e) Standardization of equipment ratings, common inventory management systems etc.
f) Adoption of new technologies for resilience infrastructure.
g) As far as possible, the layout of the distribution networks should form a ring for better operational convenience, reliability and fast restoration particularly for any town or city.

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Chapter-7

7. Disaster Risk Reduction and Building resilience – The Responsibility Framework

Managing disaster risk and building resilience requires involvement of multiple agencies at different levels from the local power establishments, local administrative bodies and communities to the central ministries, departments and agencies. For disaster risk management plans to succeed, it is necessary to identify various stakeholders/agencies and clearly specify their roles and responsibilities. All agencies must carry out not only their own responsibilities but also work in a well-coordinated way with several others.

The nature of the task of building disaster resilience is presented in a concise form in this chapter along with the necessary detailed responsibility framework. This chapter covers hazards and disaster situations listed below:

1. Fire
2. Cyclone
3. Flood
4. Earthquake
5. Tsunami
6. Landslide and Snow Avalanche
7. Thunderstorm & Lightning, Squall, Dust Storm, and Strong Wind
8. Pandemic/Epidemic

The primary role of the central agencies in most disasters and emergencies is of providing various types of support to disaster-affected State or UT, usually in response to requests for assistance. However, in certain disasters or when the situation requires, central agencies play a pro-active role. In domains of DM planning, preparedness, and capacity building, central agencies should constantly work to upgrade the DM systems and practices as per global trends.

7.1 Thematic Areas for Disaster Risk Management

The measures required to be taken to achieve four priority areas of disaster risk reduction as identified under Sendai Framework i.e. (1) Understanding disaster risk, (2) Strengthening disaster risk governance to manage disaster risk, (3) Investing in disaster risk reduction for resilience & (4) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction are grouped under the following six thematic Areas:

1. Understanding Risk - This Thematic Area for DRM focuses on understanding disaster risk - Priority-1 of the Sendai Framework, and integrates into it

numerous actions needed for strengthening disaster resilience. The major themes for action are: a) Observation Networks, Information Systems, Research, Forecasting, b) Zoning/ Mapping, c) Monitoring and Warning Systems, d) Hazard Risk and Vulnerability Assessment (HRVA), and e) Dissemination of Warnings, Data, and Information. Having adequate systems to provide warnings, disseminate information, and carry out meaningful monitoring of hazards are crucial to disaster risk reduction, and improving resilience. They are also an integral part of improving understanding of the risk.

2. Inter-Agency Coordination - Inter-agency coordination is a key component of strengthening disaster risk governance - Priority-2 of the Sendai Framework. The major themes for action required for improving top-level interagency coordination are: a) Overall disaster governance b) Response c) Providing warnings, information, and data and d) Non-structural measures. The central ministries and agencies mentioned are those vested with hazard-specific responsibilities by Govt. of India or those expected to play major roles in the thematic areas given in the matrix.

3. Investing in DRR: Structural Measures - Undertaking necessary structural measures is one of the thematic areas for DRM and enhancing resilience. These consist of various physical infrastructures and facilities required to help communities cope with disasters. The implementation of these measures is essential to enhance disaster preparedness, a component of Priority-4 of the Sendai Framework. It is also an important component of investing in disaster risk reduction for resilience, which is Priority-3 of Sendai Framework.

4. Investing in DRR: Non-Structural Measures - Sets of appropriate laws, mechanisms, and techno-legal regimes are crucial components in strengthening disaster risk governance to manage disaster risk, which is Priority-2 of the Sendai Framework. These non-structural measures comprising of laws, norms, rules, guidelines, and techno-legal regimes (e.g., building codes) provide the legal regime that facilitates mainstreaming disaster risk reduction into development activities. It empowers the authorities to enhance disaster resilience. The central and state governments will have to set up necessary institutional support for enforcement, monitoring, and compliance.

5. Capacity Development - Capacity development is a recurring theme in all DRM efforts. The Sendai Priority-2 (Strengthening DRR governance to

manage DR) and Priority-3 (Investing in DRR for resilience) are central to capacity development. The capacity development includes training programs, curriculum development, large-scale awareness creation efforts, and carrying out regular mock drills and disaster response exercises. The capabilities to implement, enforce, and monitor various disaster mitigation measures must be improved at all levels from the local to the higher levels of governance. It is also strengthening the DRR governance at all levels to better manage risk and to make the governance systems more responsive.

6. Climate Change Risk Management - Climate change significantly alters the geographic spread, frequency and intensity of hydro-meteorological extreme events. It can also exacerbate their impacts. Investments in DRR can play an important role in supporting communities to adapt to climate change. As the impacts of climate change are increasingly felt, more financial and technical resources will be needed to support vulnerable people to adapt to the negative impacts. Planning for DRR must be informed by the likely climate change impacts and scenarios. There are major knowledge and data gaps concerning climate change impacts, impact scenarios and its effects on various hydro-meteorological hazards, which need to be kept in mind while examining the time frames and actions listed under this Thematic Area for DRM.

The chapter presents responsibility matrix for the six Thematic Areas (TA) and related Sub-Thematic Areas for DRM as envisaged under Sendai Framework: viz. Understanding Risk, Inter-Agency Coordination, Investing in DRR – Structural Measures, Investing in DRR – Non-Structural Measures, Capacity Development & Climate Change Risk Management for each hazard in the succeeding sub-sections. The responsibility matrix for Inter-Agency Coordination, Investing in DRR – Non-Structural Measures & Capacity Development are common for the power sector specifically and applicable to all types of hazards.

Box-7.1: Six Thematic Areas (TA) of action to achieve the four priority envisaged under Sendai Framework:

- Understanding Risk,
- Inter-Agency Coordination
- Investing in DRR – Structural Measures
- Investing in DRR – Non-Structural Measures
- Capacity Development
- Climate Change Risk Management

7.2 Fire – The Responsibility Matrix

Table-7.2.1: Understanding Risk (Fire)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibilities of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Understanding Risk	MHA*, MHUA, MoEFCC, Other relevant Ministries/ Departments	**Recurring/ Regular (RR)** • Technical support • Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, F&ES, SDRF, INDD, SPCB, DISH, ULBs, PRIs, DDMA, SLRTI, Other Departments	**Recurring/ Regular (RR)** • Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** • Applying the classification system for hazardous industries in rural and urban areas based on norms laid down by the SFAC for fire services • Vulnerability analysis of densely population clusters prone to high risk of fire • Disaster Damage and Losses 2005-2015 baseline **Medium Term (T2)** • Mapping of hazardous sites that pose fire and explosion risks • Assess and fix the requirement of equipment and manpower • Identifying areas prone to forest fires and take preventive measures	Support and Coordination

Table-7.2.2: Capacity Development (Fire)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Capacity Development	MHA, NDMA, NIDM, NDRF, Other relevant Ministries/ Departments	**Recurring/ Regular (RR)** • Provide guidance and support to SDRF, CDEF, community, and volunteers • TOT programs on various aspects such as firefighting, managing collapsed structure, and search and rescue	DMD, SDMA, SDRF, SIDM, ATI, F&ES, SDRF, CDEF, ULBs, PRIs, DDMA, SIRD, SLRTI	**Recurring/ Regular (RR)** • Advanced training on disaster management CDEF, community, and volunteers • Promoting culture of awareness, alertness and preparedness • Awareness generation programs for public, utilities, ULBs, PRIs, and industries • IEC materials and ensure wider disseminate to general public through all medium • Information on safety, care and protection of disaster-affected animals • TOT programs on various aspects such as firefighting, managing collapsed structure, and search and rescue **Medium Term (T2)** • Address the capability gaps - human and institutional • Strengthening and standardizing response mechanisms	As indicated in Table-7.12.

7.3 Cyclone – The Responsibility Matrix

Table-7.3.1: Understanding Risk (Cyclone)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Observation Networks, Information Systems, Monitoring, Research, Forecasting, Early Warning	MoES*, DoS, MoST, MOJS, MEITY, NLRTI, MOEFCC	**Recurring/ Regular** • Promote research and studies – both in-house and extra-mural by providing research grants to researchers and institutions • Study on ecosystem and shoreline changes • Promote availability in public domain cyclone database and forecasts **Short-Term (T1)** • Enhancement of Observational Network Stations (ONS) • Establishment of planned Automatic Weather Stations (AWS) and Rain-Gauge Network (RGN) • Enhancement of a Doppler Weather Radar Network over coastal regions • Integration of all ONS with AWS & RGN in one single platform **Medium Term (T2)** • Modernization of observation network, equipment, systems, technology • Establishment of at least one High Wind Speed Recorder and one surge recorder for each coastal district, vulnerable to cyclones	DMD, SDMA, RD, SLRTI, DDMA, PRIs, ULBs	**Recurring/ Regular** • Support and coordination • Sponsor studies, research and documentation • Promote studies on socio-economic impacts of cyclone and wind hazards. **Short Term (T1)** • Constitute State Level Coastal Advisory • Committees as per need **Medium Term (T2)** • Studies on socio economic on coping capabilities and impacts.	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			• Aircraft Probing of Cyclones **Long Term (T3)** • Land- and Ocean-based observation systems • Research and studies to improve forecasts • Augmentation of high resolution vertical soundings and DWR network • Airborne Doppler Weather Radar (ADWR) • Airborne Laser Terrain Mapping (ALTM) • Establish atmospheric observational network complemented by multi-platform satellite and aircraft-based profiler observations			
2	Zoning/ Mapping	MoES*, DoS, MoEFCC, MoST, NLRTI	**Recurring/ Regular** Support the preparation of detailed maps to delineate coastal wetlands, mangroves and shelterbelts and tracts for coastal bio-shields using best tools, field studies, and satellite data	SDMA, SLRTI, DDMA	**Recurring/ Regular** Carry out the mapping and related studies	Support and coordination
3	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MoES*, MoST, MoEFCC, MSJE, NLRTI, NDMA, NIDM	**Recurring/ Regular** • Promote studies, documentation and research • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects • Provide technical support and guidance for comprehensive HRVCA	SDMA, DDMA, DMD, SLRTI, RD, DSJE, PRIs, ULBs	**Recurring/ Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans, and for development planning **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
4	Dissemination of warnings, data, and information	MoES* MOIB, MEITY, MOST, MCOM	**Recurring/ Regular** • Quick, clear, effective dissemination among central and state agencies • Deployment of communication equipment • Warnings using all types of options, types of technologies, and media • Providing weather information online and offline and interface with mobile network service • Providing warnings on radio, TV, and cell phones **Medium Term (T2)** • Facilitating last-mile connectivity and access to disaster risk information	DMD, SDMA, DDMA, RD, PRIs, ULBs,IPRD	**Recurring / Regular** • Dissemination of warnings to all (including fishermen), down to the last mile – remote, rural or urban; Regular updates to people in areas at risk • Warnings using all types of options, types of technologies, and media • Monitoring compliance by various network operators and service providers **Short Term (T1)** • Establishing seamless interface between national and state networks **Medium Term (T2)** • Ensure facilities and infrastructure for the implementation of adequate access of information to communities at risk • Deployment of communication equipment	Control Rooms at Center/ Regional/ State to coordinate with Central /State Authorities and disseminate early warning signals at local control room level.

Table-7.3.2: Inter-Agency Coordination (Cyclone)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MoES*	**Recurring/ Regular** • Providing coordination, technical inputs, and support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development	As indicated in Table-7.10.
2	Response	MHA	**Recurring/ Regular** • Organising and coordinating central assistance	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Organising and coordinating the immediate response • Coordinate with central agencies	
3	Warnings, Information, Data	MoES*, MEITY, NDMA	**Recurring/ Regular** • Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordinating the dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	
4	Non-structural measures	MHA, NDMA, BIS	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring	

Table-7.3.3: Investing in DRR – Structural Measures (Cyclone)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms /Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Hazard resistant construction, strengthening, and retrofitting of all power plant structures and critical infrastructure	MoP, BIS, CEA	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines /norms/ standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** • Monitoring of adherence to the guidelines /norms/standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• Structures are to be designed taking into account the wind loads and its effect on the structures as per the IS 875 Part-III Code • Very tall structures like chimney and natural drought cooling towers, model studies in wind tunnel must also be invariably carried out to minimize the possibility of any damage to these tower structures under extreme wind conditions. • Ensure that cyclone-resistant features are incorporated in planning and execution of power infrastructure. • Existing overhead distribution system should be replaced with the underground cable system in cyclone-prone areas. Where the underground system cannot be adopted, bare overhead conductor should be converted to ABC cables. • In order to mitigate the effects of increased wind speeds on power transmission due to changes in climatic patterns, technologies like Cables, Utility tunnels, Gas insulated lines (GIL) & HVDC ELPIPES to be explored.

Table-7.3.4: Capacity Development (Cyclone)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Training	NIDM, NDMA, NLRTI, NDRF,	**Recurring/ Regular** • Training and orientation programs for central govt. staff, SDRF, CDEF, Community, Volunteers and other direct stakeholders	DMD, SDMA, DDMA, RD, SIDM, ATI, Technical Training Institutes, SIRD, Police Training Academies, AHD	**Recurring/ Regular** • Training and orientation programs for state govt. staff, and other direct stakeholders such as: civil society, media-persons, elected representatives, professionals for veterinary care and support to disaster-affected animals	As indicated in Table-7.12.
		NDMA, NIDM, NDRF, MoYAS, MOD	**Recurring/ Regular** • Incorporating disaster response, search and rescue in the training programs of youth such as NCC, NYKS, Scouts and Guides and NSS	DMD, SDMA, DDMA, RD, SIDM,ATI	**Recurring/ Regular** • Incorporating disaster response, search and rescue in the training programs of youth such as village volunteers, protection of disaster-affected animals	
2	Curriculum Development	MHRD, UGC, NIDM, NLRTI	**Medium Term (T2)** Update curriculum for undergraduate engineering courses to include topics relevant for cyclone Risk Management	EDD, Professional Bodies and Councils in States	**Medium Term (T2)** Update curriculum for undergraduate engineering courses to include topics relevant for cyclone Risk Management	
		MoHFW, NLRTI	**Medium Term (T2)** Introduction of Crisis Management, emergency medical response/recovery and trauma management at Diploma /UG/ PG levels for Health Professionals	HFWD/EDD	**Medium Term (T2)** Introduction of Crisis Management, emergency medical response/recovery and trauma management at Diploma /UG/ PG levels for Health Professionals	
		CBSE	**Medium Term (T2)** Introducing basic DM concepts in curriculum	State Education Boards	**Medium Term (T2)** Introducing basic DM concepts in curriculum	

3	Awareness Generation	NDMA, NDRF, CAPF, NIDM, MOES	**Recurring/ Regular** • Carry out mass media campaigns • Promote attitude and behaviour change in the awareness campaigns/ IEC **Long Term (T3)** • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote use of insurance/ risk transfer • Promote Community Radio • Strengthening network of civil society organizations for awareness generation about DRR and DM	DMD, SDMA, RD, DDMA, SDRF, F&ES, CDEF, Police	**Recurring/ Regular** • Carry out mass media campaigns • Promote attitude and behaviour change in the awareness campaigns/ IEC **Long Term (T3)** • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote use of insurance/ risk transfer • Promote Community Radio • Strengthening network of civil society organizations for awareness generation about DRR and DM • Information on care and protection of disaster-affected animals	
4	Mock Drills/ Exercises	NDMA, NDRF, MoD, CAPF	**Recurring/ Regular** Promoting the planning and execution of emergency drills by all ministries and in all States/UTs	DMD, SDMA, RD, DDMA, SDRF, F&ES, CDEF, Police	**Recurring/ Regular** Joint planning and execution of emergency drills	
5	Vocational Training/ Skill Development	NDMA, NIDM, MSDE, NSDA, NSDC, IIE, NIESBUD, MIMSME, NLSDA	**Recurring/ Regular** Promoting skill development for multi-hazard resistant construction in cyclone-prone areas for different types of housing and infrastructure	DMD, SDMA, DDMA, RD, SLSDA	**Recurring/ Regular** • Conduct training programmes • Creating ToT teams for different trades relevant to cyclone-resistant construction	
6	Empowering women, marginalised communities, and persons with disabilities	MSJE, MWCD, NDMA, NIDM	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management	DMD, SDMA, RD, SIDM, ATI, DDMA, PRIs, ULBs	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management at the state, district, and local levels	

7	Community-Based Disaster Management	NDMA, NIDM, NDRF, MoD, CAPF, MORD, MHUA	**Recurring/ Regular** Promotion, Guidance, and Support	DMD, SDMA, RD, DDMA, SIDM, ATI, PRIs, ULBs	**Recurring/ Regular** • Training for PRI, SHG, NCC, NSS, youth, local community organizations **Short Term (T1)** • Strengthen ability of communities to manage and cope with disasters based on a multi- hazard approach	

Table-7.3.5: Climate Change Risk Management (Cyclone)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1.	Research, Forecasting, Data Management, Zoning, Mapping	MoES*, DoS, MoST, MoEFCC, MoAFW, NDMA, NLRTI	**Recurring/ Regular** • Promote studies and research on climate change-related risks and adaptation options **Short Term (T1)** • Develop GACC impact scenarios that have bearing on cyclonic activity and sea surges • Studies on GACC driven ecosystem and shoreline changes • Assess enhanced risks (economic, social, etc.) under different GACC impact Scenarios • Carry out risk zonation/mapping of climate change impacts considering various sea-level rise and shoreline change scenarios • Research studies on mutual coherence and mutual reinforcement of GACC and risk management along the coast **Long Term (T3)** • Develop Data base management system for GACC impacts • Develop forecasting model for risks from GACC and its likely impacts	DMD, SDMA, RD, AGD, AHD, FIHD, WRD, EFD, SLRTI	**Recurring/ Regular** • Support national risk reduction efforts related to GACC • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium Term (T2)** • Document state-specific GACC impacts and coping mechanisms **Long Term (T3)** • Promote state-specific studies on enhanced risks (economic, social, etc.) under different GACC impact scenarios • Promote research studies with State specific contexts on GACC and consequent changes in hazards	Support and coordination
2.	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MoES*, NIDM, MoEFCC, NLRTI	**Long Term (T3)** • Assess the changes in risk, vulnerability and capacities under GACC impact scenarios	DMD, SDMA, RD, EFD, AGD, FIHD, WRD DDMA,	**Long Term (T3)** • Promote state-specific studies on vulnerabilities, capacities and risks under GACC impact scenarios	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			• Assess GACC risks of vulnerable and marginalised sections • Provide technical support and guidance for comprehensive HRVCA considering GACC impacts	PRIs, ULBs, SLRTI	• Assess GACC risks of vulnerable and marginalised sections	
3.	Climate Change Adaptation (CCA)	MoES*, MoST, DoS, MoJS, MoAFW, MoEFCC	**Medium-Term (T2)** • Understanding CCA needs • Study GACC coping mechanisms • Develop CCA mechanisms **Long Term (T3)** • Promote appropriate combinations of Green and Blue infrastructure approach • Support the implementation of GACC adaptation programs • Promote adaptive measures in social protection programmes for the vulnerable groups	DMD, SDMA, EFD, RD, Agriculture Dept., WRD DDMA, PRIs, ULBs	**Recurring/Regular** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium Term (T2)** • Develop local adaptation strategies and pilot projects **Long Term (T3)** • Sponsor and promote state-specific efforts and local efforts • Promote appropriate combinations of Green and Blue infrastructure approach • Implementation of GACC adaptation programs • Integrate adaptive measures in social protection programmes for the vulnerable groups	Support and coordination

7.4 Flood – The Responsibility Matrix

Table-7.4.1: Understanding Risk (Flood)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Observation Networks, Information Systems, Monitoring, Research, Forecasting, Early Warning	MoES*, MoJS, MoAFW, DoS, MEITY, NLRTI	**Recurring/ Regular** • Assessment, Monitoring, and Scientific studies **Short Term (T1)** • Preparation of close contour and flood vulnerability maps • Modernisation of flood forecasting and warning systems on a river basin basis • Assist States/UTs in identification of priority flood protection and drainage improvement works • Monitoring of flood preparedness, river basin and reservoir management plans **Medium Term (T2)** • Studies and monitoring of rivers flowing from neighbouring countries. • Studies involving international cooperation for forecasting and cross border issues. • Implementation of the schemes for real-time collection of hydro-meteorological data on important rivers including the relevant rivers flowing from Nepal, Bhutan and China • Specialized efforts for different types of floods and causes of flooding, including cloudburst.	DMD, IRD., WRD, SDMA, DDMA, SLRTI, PRIs, ULBs	**Recurring/ Regular** • Support and cooperate with central agencies • Sponsor state-specific efforts; support local efforts for flood management • Support local information systems and update data for better flood management **Short Term (T1)** • Implementing and monitoring of flood preparedness, river basin and reservoir management plans including updating rule curves, improve system of water release from reservoirs • Identification of priority flood protection and drainage improvement **Medium Term (T2)** • Studies on land use and hydrological changes relevant to flood management in river basins and reservoir command areas	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			Long Term (T3) • Developing/improving/updating forecasting methods and models for quantification of inflows and storage of dams.		**Long Term (T3)** • Execution of flood protection and drainage improvement schemes	
2	Zoning, mapping, and classification flood prone areas	MoJS, DoS, NLRTI	**Short Term (T1)** Preparation of large-scale hazard maps of flood prone areas identifying areas of high vulnerability	DMD, IRD, SLRTI, WRD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Regular** • Support and cooperate with central agencies • Sponsor state-specific efforts; support local efforts	Support and coordination
3	Research & Development	MOJS, DOS, MOST, NLRTI, Brahmaputra Board, Ganga Flood Control Commission	**Short Term (T1)** • Studies on support systems for people living in flood prone areas • Evolving designs of shelters in flood prone areas • Socio-economic impacts of flood **Medium Term (T2)** • River basin studies • Studies on flood related problems such as soil losses caused by flooding of rivers, sediment transport, river course changes, and appropriate use of embankments • Promote research and studies - both in-house and extra-mural by providing research grants to researchers and institutions **Long Term (T3)** • Hydrological and morphological studies before undertaking major flood control or prevention measures • Developing/ updating forecasting methods and models for quantification of inflows and storage of dams	DMD, IRD, WRD, SDMA, DDMA, SLRTI	**Recurring/ Regular (RR)** • Support and cooperate with central agencies • Sponsor/ carry out state-specific efforts in all these areas; support local efforts	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
4	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	NDMA, NIDM, MoJS, MoST, MSJE, NLRTI	**Regular/ Recurring** • Promote studies, documentation and research • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects • Provide technical support and guidance for comprehensive HRVCA	DMD, SDMA, DDMA, RD, IRD, DSJE	**Recurring/ Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support and coordination
5.	Dissemination of warnings, data, and information	MOES, MOJS MEITY, MCOM, MOIB, MEA NDMA, DOS	**Recurring/ Regular (RR)** • Quick, clear, effective dissemination among central and state agencies. **Short Term (T1)** • Facilitate the distribution of necessary communication equipment, last-mile connectivity and access to disaster risk information • International cooperation to share warnings about rivers flowing from neighbouring countries • Promoting reliable networking systems for data and information sharing among central and state agencies • Monitoring of landslides and blockages in rivers • Warning systems • Providing information in all possible ways and using all types of media • Interface with mobile network service providers for warnings	DMD, SDMA, RD, IRD, WRD, IPRD, DDMA, PRIs, ULBs	**Recurring/ Regular (RR)** • Inter-state data and information sharing where applicable • Coordination and cooperation with the central agencies • Ensure facilities and infrastructure for the implementation of adequate access to communities at risk • Dissemination of warnings to all, down to the last mile - remote, rural or urban; Regular updates to people in areas at risk • Warnings using all types of options, types of technologies, and media • Monitoring compliance by various network operators and service providers	Control Rooms at Center/ Regional/ State to coordinate with Central /State Authorities and disseminate early warning signals at local control room level.

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
6.	Disaster Data Collection and Management	MHA, MOSPI, all ministries/ depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, all depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline

Table-7.4.2: Inter-Agency Coordination (Flood)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MoJS	**Recurring/ Regular** • Providing coordination, technical inputs, and support	DMD, SDMA, RD, IRD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development	As indicated in Table-7.10.
2	Response	MHA	**Recurring/ Regular** • Organising and coordinating central assistance	DMD, SDMA, RD, IRD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Organising and coordinating the immediate response • Coordinate with central agencies	
3	Warnings, Information, Data	MoJS, IMD, DoS, MEITY, NDMA	**Recurring/ Regular** • Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordinating the dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	
4	Non-structural measures	MHA, BIS, NDMA	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring	

Table-7.4.3: Investing in DRR – Structural Measures (Flood)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms/Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Flood control measures	MoP, BIS, CEA	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• Floodwalls can be established around the substation, and floating or amphibious concepts could also be potentially used in flood prone areas. • In case of hydropower projects particularly located in susceptible cloudburst areas, storage dams should also be constructed in each basin which can mitigate flash floods by storing the sudden flow of water caused by flash floods due to cloud bursts in the reservoir area. • Dam Burst computer simulation studies should normally be done to assess the impact of the failure of a major dam on the downstream side and for assessing the damages likely to occur.
2	Hazard resistant construction, strengthening, and retrofitting of all lifeline structures and critical infrastructure	MoP, BIS, CEA	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• No power project should be located within the flood zone corresponding to a 100 years' frequency or the maximum observed flood level. • Substations of transmission & distribution networks should be built on a raised platform above-defined flood level and overhead lines should be strengthened.

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms/Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
							• The formation level of power plants is kept at least 1.0 m above any damage due to floods. • Flood damage can also be prevented by using GIS Substation, saltwater – resistant equipment which is less susceptible to damage resulting from inundation. • Designing the drainage system of the thermal power plant for a 1 in 50-year frequency rainfall event for the power block area and for the main access roads.

Table-7.4.4: Capacity Development (Flood)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1.	Training	NIDM, LBSNAA, NIRM, NDMA, NDRF, NISA, NIC, and other training institutions for Indian Civil Services	**Recurring/ Regular** Training and orientation programs for central govt. staff, SDRF, CDEF, communities and volunteers	DMD, SDMA, DDMA, ATIs, Engineering Training Institutes, SIRD, Police Training Academies	**Recurring/ Regular** • Training and orientation programs for state govt. staff, professionals for veterinary care and support to disaster- affected animals • Training to CDEF, community and volunteers	As indicated in Table-7.12.
		NDRF, CAPF, MoYAS, MoD	**Recurring/ Regular** Incorporating disaster response, search and rescue in the training programs of youth such as NCC, NYKS, Scouts and Guides, NSS, SDRF, CDEF, Communities and Volunteers	DMD, SDMA, SIDM, ATI DDMA, PRIs, ULBs	**Recurring/ Regular** • Incorporating disaster response, search and rescue in the training programs of youth such as village volunteers, and for protection of disaster-affected animals • Training to CDEF, community and volunteers	
2.	Curriculum Development	MHRD, AICTE, IITs, UGC, NIDM, Professional Bodies/ Councils	**Recurring/Regular** Strengthen coverage of flood damage mitigation, flood tolerant designs/ crops, and construction techniques	Professional Bodies/ Councils	**Medium Term (T2)** Update curriculum for undergraduate engineering courses to include topics relevant for flood Risk Management	
		MoHFW	**Recurring/Regular** Improve coverage of community health and epidemic management medical curriculum	Health Department	**Medium Term (T2)** Introduction of Crisis Management, emergency medical response/recovery and trauma management at Diploma /UG/ PG levels for Health Professionals	
		CBSE	**Recurring/Regular** Include awareness about flood and some aspects of flood management in school and college teaching while reviewing the curriculum	Boards of Education	**Recurring/ Regular** Improving curriculum periodically using new technologies	

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
3.	Awareness Generation	NDMA, NDRF, CAPF, NIDM, MoJS	**Recurring/Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Strengthening network of civil society organizations for awareness generation about DRR and DM **Medium Term (T2)** • Promote use of insurance/ risk transfer • Promote Community Radio	DMD, SDMA, RD, WRD, IRD, SDRF, F&ES, CDEF, Police, DDMA, PRIs, ULBs	**Recurring/Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Strengthening network of civil society organizations for awareness generation about DRR and DM • Information on care and protection of disaster-affected animals **Medium Term (T2)** • Promote use of insurance/ risk transfer • Promote Community Radio	
4	Mock Drills/ Exercises	NDMA, NIDM, MoJS, Line Ministries, Govt. Agencies, NDRF, Armed Forces, CAPF	**Recurring/ Regular** Promoting the planning and execution of emergency drills by all ministries and in all States/UTs	DMD, SDMA, RD, WRD, IRD, SDRF, F&ES, CDEF, Police, DDMA, PRIs, ULBs	**Recurring/ Regular** Joint planning and execution of emergency drills	
5	Vocational Training/ Skill Development	NDMA, NIDM, MSDE, NSDA, NSDC, IIE, NIESBUD, MIMSME, NLSDA	**Recurring/ Regular** Promoting skill development for multi-hazard resistant construction in flood-prone areas for different types of housing and infrastructure	DMD, SDMA, DDMA, RD, SLSDA	**Recurring/ Regular** • Conduct training programmes • Develop a team of Trainer-of-Trainers for different trades relevant to flood- resistant construction	
6	Empowering women, marginalised,	MSJE, MWCD, NDMA, NIDM	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in	DMD, SDMA, RD, SIDM, ATI, and	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development	

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
	and persons with disabilities		capacity development covering all aspects of disaster management	other state-level institutions, DDMA, PRIs, ULBs	covering all aspects of disaster management at the state, district, and local levels	
7	Community-Based Disaster Management	NDMA, NIDM, MoRD, MHUA	**Recurring/ Regular** Promotion, Guidance, and Support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach • Training for PRIs, SHG, NCC, NSS, Youth, local community organizations	

Table-7.4.5: Climate Change Risk Management (Flood)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Research, Forecasting / Early Warning, Data Management, Zoning, Mapping	MoES, MoJS, MoAFW, MoEFCC, DoS	**Recurring/ Regular** • Assessment, Monitoring, and Scientific studies **Short Term (T1)** • Flood vulnerability maps under GACC scenarios • Assessing GACC effects on catchments and river basins including trends over past decades. • Assess enhanced economic and social risks under GACC scenarios **Medium Term (T2)** • Study GACC-related changes in the rivers flowing from trans-boundary rivers • Develop Database management system relating to climate change impact on floods • Prepare GACC scenario maps for all river systems • Enhanced risks from GACC and on adaptations to change **Long Term (T3)** • Improve the flood forecasting capabilities consistent with the anticipated GACC impacts on flood-prone areas • Coordinate with all neighbouring countries to understand and monitor GACC impacts on major rivers associated with or flowing from neighbouring countries	DMD, EFD, IRD, WSD*, SDMA, AGD, FIHD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Support national risk reduction efforts related to GACC • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium Term (T2)** • Document state-specific GACC impacts and coping mechanisms **Long Term (T3)** • Promote state-specific studies on enhanced risks (economic, social, etc.) under different GACC impact scenarios • Promote research studies with State specific contexts on GACC and consequent changes in hazards	Support and Coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
2.	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	NIDM, MoJS, MoST, MoST, CSIR, DoS	**Medium Term (T2)** • Improve the understanding of the enhanced vulnerabilities of communities in flood-prone areas to extreme hydro- climatic events • Assess GACC risks of vulnerable and marginalised sections • Provide technical support and guidance for comprehensive HRVCA considering GACC impacts **Long Term (T3)** • Undertake detailed studies on vulnerability and risk under GACC scenarios along the coast	State / UT, SDMA, DMD, RD, Irrigation Dept. / WRD	**Recurring/Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans • Develop strategies for structural and non-structural measures based on HRVCA **Medium Term (T2)** • Assess GACC risks of vulnerable and marginalised sections	Support and Coordination
3.	Climate Change Adaptation (CCA)	MoES*, MoEFCC*, MoST, DoS, MoJS, MSJE	**Short-Term (T1)** • Understanding adaptation needs • Study coping mechanisms • Develop GACC adaptation mechanisms **Medium & Long Term (T2, T3)** • Implement GACC adaptation programs • Promote appropriate combinations of Green and Blue infrastructure approach • Promote adaptive measures in social protection programmes for the vulnerable groups	SDMA, IRD/WRD*, EFD, DRD, DSJE, DDMA, PRIs, ULBs	**Recurring/ Regular** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium –Term (T2)** • Develop local adaptation strategies and pilot projects **Long Term (T3)** • Sponsor and promote state-specific efforts and local efforts • Implementation of GACC adaptation programs • Promote appropriate combinations of Green and Blue Infrastructure Approach • Integrate adaptive measures in social protection programmes for the vulnerable groups	Support and Coordination

7.5 Earthquake – The Responsibility Matrix

Table-7.5.1: Understanding Risk (Earthquake)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	• Earthquake Monitoring Services • National Seismological Network • Real Time Seismic Monitoring Network (RTSMN) • Earthquake Hazard and Risk Assessment (EHRA)	MoES, MEITY, NLRTI	**Recurring/ Regular** • Estimate the earthquake parameters quickly after detection • Disseminate information • Share information relating to undersea earthquakes capable of generating tsunamis in the Indian coastal regions with INCOIS to issue of tsunami related messages and warnings • Share seismic activity data with national and international scientific, academic and R&D institutions **Medium Term (T2)** • Seismic hazard assessment • Seismic zoning • Seismic micro-zoning	DMD, SDMA, DDMA, RD	**Recurring/ Regular** Share information widely	Support and coordination
2	Scientific Seismic Zonation	MoES, EREC, BIS, GSI, NLRTI, MoST	**Short Term (T1)** Inter-Agency Coordination and Collaboration for publishing the guidelines	DMD, SDMA, RD, UDD, SPWD, ULB, DDMA	**Recurring/ Regular** Ensuring implementation, enforcement, compliance and monitoring; Awareness creation	Support and coordination
3	Seismic Micro-zonation	EREC, NLRTI	**Medium Term (T2)** • Develop a status paper based on a consensus among the professionals on the	DMD, SDMA, RD, DDMA, SLRTI	**Long Term (T3)** • Carry out needs assessment from end-users, conduct micro-zonation studies,	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			methodologies for micro-zonation studies		prioritize important urban areas for micro-zonation, do professional review before adoption	
4	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	NDMA, NIDM, MoST, MSJE, NLRTI	**Recurring/ Regular** • Promote studies, documentation and research • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects • Provide technical support and guidance for comprehensive HRVCA	DMD, SDMA, RD, DSJE, PRIs, ULBs, DDMA	**Recurring/ Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support and coordination
5.	Disaster Data Collection and Management	MHA, MOSPI, all ministries/ depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, all depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline

Table-7.5.2: Inter-Agency Coordination (Earthquake)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MoES	**Recurring/ Regular** • Providing coordination, technical inputs, and support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development	As indicated in Table-7.10.
2	Response	MHA	**Recurring/ Regular** • Organising and coordinating central assistance	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Organising and coordinating the immediate response • Coordinate with central agencies	
3	Non-structural measures	MoES, MHA, BIS, NDMA	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring	

Table-7.5.3: Investing in DRR – Structural Measures (Earthquake)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms /Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Hazard resistant construction, strengthening, and retrofitting of all power plant structures and critical infrastructure	MoP, BIS, CEA, MoJS, CWC	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• In the case of Hydro-electric projects and especially large dams, site-specific seismic studies of the project area need to be carried out and the design of structures should be finalized accordingly. • Power supply installations are to be located to avoid high seismic zones. • Adoption of IS 1893 (Part 4) for industrial structures (plant and auxiliary structures) including stack-like structures that deal with earthquake-resistant design.

Table-7.5.4: Capacity Development (Earthquake)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Training	MoES*, NIDM, MHRD, NDMA, MoYAS, others	**Recurring/Regular** • Support regular training • Training support for SDRF, CDEF, community, volunteers. **Medium Term (T2)** • Promote a national effort to build the requisite number of trained personnel to handle seismic safety in India.	DMD, SDMA,SDRF, RD, EDD, ATIs, SIRD, DDMA	**Recurring/ Regular (RR)** • Carry out regular training of CDEF, community and volunteers **Medium Term (T2)** • Carry out the national effort to build the requisite number of trained personnel to handle seismic safety in India • Training in search and rescue for CDEF, community, and volunteers	As indicated in Table-7.12.
2	Curriculum Development	MoES, MCI, MHRD, UGC, AICTE, IITs, NIDM and other related agencies	**Medium Term (T2)** Facilitate the introduction of subjects related to DM, in the undergraduate and professional courses	DMD, SDMA, RD, HD,EDD, DDMA	**Medium Term (T2)** DM related aspects to be included in undergraduate and professional courses	
3	Awareness Generation	NDMA, NDRF, CAPF, NIDM	**Recurring/Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC **Medium Term (T2)** • Promote use of insurance/ risk transfer • Promote Community Radio	DMD, SDMA, IPRD, RD, SIDM, ATIs, SDRF, F&ES, CDEF, Police, DDMA, PRIs, ULBs	**Recurring/Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC **Medium Term (T2)** • Promote use of insurance/ risk transfer • Promote Community Radio • Strengthening network of civil society organizations for awareness	

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			• Strengthening network of civil society organizations for awareness generation about DRR and DM		generation about DRR and DM • Information on care and protection of disaster-affected animals	
4	Mock Drills/ Exercises	NDMA, All Government Ministries/ Agencies, NDRF, Armed Forces, CAPF	**Recurring/ Regular** Monitoring Emergency Preparedness of Ministries/ Departments **Short Term (T1)** Promoting the planning and execution of emergency drills by all ministries and in all States/UTs	DMD, SDMA, IPRD, RD, SIDM, ATIs, SDRF, F&ES, CDEF, Police, DDMA, PRIs, ULBs	**Recurring/ Regular** Monitoring Emergency Preparedness of Departments **Short Term (T1)** Joint planning and execution of emergency drills	
5	Documentation and Dissemination	MoES, NIDM	**Recurring/ Regular** Undertake documentation of major earthquakes and ensure wider dissemination	DMD, SDMA, RD, DDMA, PRIs, ULBs, ATI	**Recurring/ Regular** Popularization and distribution of documentation in local languages	
6	Empowering women, marginalised, and persons with disabilities	MWCD, MSJE, NDMA, NIDM	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management	DMD, SDMA, RD, SIDM, ATI, SLRTI, DDMA, PRIs, ULBs	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management at the state, district, and local levels	
7	Community-Based Disaster Management	NDMA, NIDM, MoRD, MHUA	**Recurring/ Regular** Promotion, Guidance, and Support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** Training for PRIs, SHG, NCC, NSS, Youth, local community organizations **Short Term (T1)** Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach	

7.6 Tsunami – The Responsibility Matrix

Table-7.6.1: Understanding Risk (Tsunami)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Research and Development Efforts	MoES*, MoST, NLRTI	**Medium Term (T2)** • Encourage development of standardised methods for tsunami risk assessment and scenario development, support studies to collect the data and compile knowledge • Develop suitable large-scale digital maps indicating the tsunami hazard basis on past tsunami events	DMD, SDMA, RD, DDMA	**Medium Term (T2)** • Develop detailed computerized maps and databases of vulnerable areas along the coast for planning and coordination of DM activities	Support and coordination
2	Zoning/ Mapping	MoES*, MoST, NLRTI	**Long Term (T3)** Database of Tsunami Risk and Vulnerability in the coastal areas with information on trends of storm surge, high tides, local bathymetry, etc.	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Ensure support to the Central Government agencies in zoning/ mapping and carry out at their level	Support and coordination
3	Observation Networks, Information Systems, Monitoring, Research, Forecasting & Early Warning	MoES*, NLRTI	**Medium Term (T2)** Assess the status of existing important installations in coastal areas to withstand tsunami	DMD, SDMA, RD, DDMA, SLRTI	**Recurring/ Regular** • Support, cooperation for data collection and updates	Support and coordination
		DoS, IAF, Indian Navy, ICG	**Medium Term (T2)** Securing critical instrumentation to ensure fail-safe functioning of these critical instruments and their protection			
4	Dissemination of warnings, data, and information	MoES*, MHA	**Recurring/ Regular** Monitoring seismic activity, provide warnings based on seismic models and issue periodic bulletins	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	Control Rooms at Center/ Regional/ State to coordinate with Central /State

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
						Authorities and disseminate early warning signals at local control room level.
5	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MoES*, NDMA, NIDM, MoST, MSJE	**Recurring/ Regular** • Promote studies, documentation and research • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects • Provide technical support and guidance for comprehensive HRVCA	DMD, SDMA, RD, DSJE, PRIs, ULBs, DDMA	**Recurring/ Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support & Coordination
6	Disaster Data Collection and Management	MHA, MOSPI, all ministries/ depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, all depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline

Table-7.6.2: Inter-Agency Coordination (Tsunami)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MoES*	**Recurring/ Regular** • Providing coordination, technical inputs, and support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development in the coastal areas	As indicated in Table-7.10.
2	Response	MHA*	**Recurring/ Regular** • Organising and coordinating central assistance	DMD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Regular** • Organising and coordinating the immediate response • Coordinate with central agencies	
3	Warnings, Information, Data	MoES*, NDMA	**Recurring/ Regular** • Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordinating the dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	
4	Non-structural measures	MoES*, MHA, BIS, NDMA	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring	

Table-7.6.3: Investing in DRR – Structural Measures (Tsunami)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms /Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Strengthening of lifeline structures and high priority buildings	MoP, CEA,	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	Implementation as per recommendations of safety audit for electrical infrastructure in the vicinity of Tsunami affected area in India
2	Designing stage	MoP, CEA,	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	Data of run-up elevations for the whole coastline shall be used as a reference for designing structures.
3	Hazard resistant construction, strengthening, and retrofitting of all lifeline structures and critical infrastructure	MoP, CEA,	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	As far as possible, the existing overhead distribution system should be replaced with underground cable system in Tsunami prone areas.

Table-7.6.4: Capacity Development (Tsunami)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1.	Training and Capacity Development of Professionals	MOES*, NIDM, MoYAS, NDRF	**Recurring/ Regular** • Technical capabilities in safety audit • Conduct training programmes for State, SDRF, and Local Administration personnel including Fire and Rescue and Police personal in disaster management • Support training of SDRF, CDEF, community, and volunteers	DMD, SDMA, SDRF, RD, ATI, SIRD, DDMA	**Recurring/ Regular** Training and orientation programs for State Govt. staff/ emergency response officials, CDEF, Community and other volunteer groups	As indicated in Table-7.12.
		MoES, NIDM, MoYAS	**Medium Term (T2)** Evolve an action plan to offer a comprehensive curriculum related to tsunami management in the form of training modules for the various target groups	ATI, SLRTI	**Recurring/ Regular** Training of the Trainers to impart knowledge related to tsunami mitigation measures to various target groups	
2	Curriculum Development	MHRD, UGC, AICTE, ICAR, etc.	**Short Term (T1)** Include DM in the educational curricula including Tsunami hazard	DMD, SDMA, RD, EDD, DDMA	**Short Term (T1)** Include DM in the educational curricula and develop adequate technical expertise on various subjects related to DM including Tsunami	
3	Awareness Generation	NDMA, NDRF, CAPF, NIDM	**Recurring/ Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Promote use of insurance/ risk transfer • Promote Community Radio • Strengthening network of civil society organizations for awareness generation about DRR and DM	DMD, SDMA, RD, DDMA, SDRF, F&ES, CDEF, Police	**Recurring/ Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Promote use of insurance/ risk transfer • Promote Community Radio • Strengthening network of civil society organizations for awareness	

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
					generation about DRR and DM • Inform people about care and protection of disaster-affected animals	
4	Mock Drills/ Exercises	NDMA, All Government Ministries/ Agencies, NDRF, Armed Forces, CAPF	**Recurring/ Regular** Joint planning and execution of emergency drills (Central and State)	DMD, SDMA, RD, DDMA, SDRF, F&ES, CDEF, Police	**Recurring/ Regular** Joint planning and execution of emergency drills (Central, State, Local and Community)	
5	Documentation	NIDM, MoES, through its nodal institutions	**Short Term (T1)** • Prepare and distribute manuals and tsunami hazard zonation maps to the public through SDMAs/ relevant Ministries and Departments • Documentation of lessons learnt, best practices, success stories	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Create awareness on tsunami risk and vulnerability among the coastal communities by distributing the hazard zonation maps • Documentation of lessons learnt, best practices, success stories	
6	Empowering women, marginalised, and persons with disabilities	MSJE*, MWCD, NDMA, NIDM	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management	DMD, SDMA, RD, SIDM, ATI, SLRTI, DDMA, PRIs, ULBs	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management at the state, district, and local levels	
7	Community - Based Disaster Management	NDMA, NIDM	**Recurring/ Regular** Promotion, Guidance, and Support to CDEF and community, volunteers	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach • Training for PRIs, SHG, NCC, NSS, Youth, local community organizations, volunteers	

Table-7.6.5: Climate Change Risk Management (Tsunami)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Research, Forecasting, Early Warning, Information Systems, Zoning, Mapping	MoES*, DoS, MoST, MoEFCC, MoAFW, NDMA, NLRTI	**Recurring/ Continuous** • Promote studies and research on climate change-related risks and adaptation options **Medium Term (T1)** • Studies on GACC driven ecosystem and shoreline changes • Carry out risk zonation/mapping of climate change impacts considering various sea-level rise and shoreline change scenarios **Long Term (T3)** • Develop database management system for GACC impacts • Develop forecasting model for risks from GACC and its likely impacts	DMD, SDMA, RD, AGD, AHD, FIHD, WRD, EFD, SLRTI	**Recurring/ Regular** • Support national risk reduction efforts related to GACC • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium (T2)** • Promote state-specific studies on enhanced risks (economic, social, etc.) under different GACC impact scenarios • Promote research studies with State specific contexts on GACC and consequent changes in hazards	Support & Coordination
2	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	NIDM, MoEFCC, MoES*, NLRTI	**Medium & Long Term (T2, T3)** • Assess the changes in risk, vulnerability and capacities under GACC impact scenarios • Assess GACC risks of vulnerable and marginalised sections • Provide technical support and guidance for comprehensive HRVCA considering GACC impacts	DMD, SDMA, RD, EFD, AGD, FIHD, WRD DDMA, PRIs, ULBs, SLRTI	**Medium & Long Term (T2, T3)** • Promote state-specific studies on vulnerabilities, capacities and risks under GACC impact scenarios • Assess GACC risks of vulnerable and marginalised sections	Support & Coordination
3	Climate Change Adaptation (CCA)	MoES*, MoST, DoS, MoJS, MoAFW, MoEFCC	**Short Term (T1)** • Understanding CCA needs • Study GACC coping mechanisms • Develop CCA mechanisms **Medium & Long Term (T2, T3)** • Support the implementation of GACC	DMD, SDMA, EFD*, FIHD, RD, AGD, WRD, DDMA,	**Recurring/ Continuous** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC	Support & Coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			adaptation programs • Promote adaptive measures in social protection programmes for the vulnerable groups	PRIs, ULBs	mitigation and adaptation **Short Term (T1)** • Develop local adaptation strategies and pilot projects **Medium & Long Term (T2, T3)** • Sponsor and promote state-specific efforts and local efforts • Promote appropriate combinations of Green and Blue infrastructure approach • Implementation of GACC adaptation programs • Integrate adaptive measures in social protection programmes for the vulnerable groups	

7.7 Landslide and Snow Avalanche – The Responsibility Matrix

Table-7.7.1: Understanding Risk (Landslide and Snow Avalanche)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Hazard Zoning, mapping, geological, and geotechnical Investigations in regions prone to landslides and snow avalanches	MoM*, MoD*, WIHG, NIDM, DoS, BRO, NLRTI**	**Recurring/ Regular** • User-friendly inventory of landslides and avalanche prone areas and its updation as per widely accepted standards **Short Term (T1)** • Preparation of high resolution / large scale Landslide and snow avalanche maps **Medium Term (T2)** • Studies and monitoring of risk prone areas on site and using satellites • Studies to classify vulnerable areas as per likelihood of hazard	DMD, SDMA, RD, State DGM, SRASC, DDMA	**Recurring/ Regular** • Support to and cooperation with central agencies	Support and coordination
2	Research and Development	MoM, MoD, MoST, NLRTI**	**Medium Term (T2)** • Scientific assessment for predicting likelihood of landslides, and better understanding of driving forces **Long Term (T3)** • R&D for methods to reduce factors driving landslide	DMD, SDMA, RD, DGM, SRASC, DDMA	**Recurring/ Regular** • Support to and cooperation with central agencies	Support and coordination
3	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MoM*, MoD*, NDMA, NIDM, MoST, MSJE	**Recurring/ Regular** • Promote studies, documentation and research • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects • Provide technical support and guidance for comprehensive HRVCA	DMD, SDMA, RD, DSJE, PRIs, ULBs	**Recurring/ Regular** • Undertake HRVCA as part of preparing and periodic revision of DM plans **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
4	Dissemination of warnings	MoM*, MoD*, MoJS, DoS, MoES, BRO	**Recurring/ Regular** • Quick, clear, effective dissemination among central and state agencies	DMD, RD, SDMA, SPWD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Ensure facilities and infrastructure for the implementation of adequate access to communities at risk • Dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	Control Rooms at Center/ Regional/ State to coordinate with Central /State Authorities and disseminate early warning signals at local control room level.
5	Monitoring, Warning Systems, and Dissemination	MoM*, MoD*, MoJS, DoS, MoES, BRO	**Medium Term (T2)** • Deploy reliable monitoring and warning systems	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Support and collaboration in implementation	Support and coordination
6	Disaster Data Collection and Management	MHA, MOSPI, all Ministries / depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, all depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline

Table-7.7.2: Inter-Agency Coordination (Landslide and Snow Avalanche)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibilities of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MoM, MoD	**Recurring/ Regular** • Providing coordination, technical inputs, and support	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development	As indicated in Table-7.10.
2	Response	MHA	**Recurring/ Regular** • Organising and coordinating central assistance	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Organising and coordinating the immediate response • Coordinate with central agencies	
3	Warnings, Information, Data	GSI, SASE, MoES (IMD), MoM, BRO, NDMA	**Recurring/ Regular** • Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordinating the dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk	
4	Non-structural measures	GSI, MHA, BIS, MoD, BRO, NDMA	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	DMD, SDMA, RD, DDMA, PRIs, ULBs	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring	

Table-7.7.3: Investing in DRR – Structural Measures (Landslide and Snow Avalanche)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms /Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Hazard resistant construction, strengthening, and retrofitting of all power plant structures and critical infrastructure	MoP, BIS, CEA	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• Design of civil structure as per the relevant BIS standard and National Building Code • Design of electrical infrastructure and civil structure as per the relevant BIS and CEA standard • Anti-icing systems to be used in power lines in hilly areas prone to snowfall. These include anti-icing coatings and other ice phobic materials. De-icing systems can also be explored which reduces the deposited ice by thermal/mechanical forces along with monitoring systems.

Table-7.7.4: Capacity Development (Landslide and Snow Avalanche)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Training	NIDM, MoM, MoD, CDMM, CoA, MoYAS, NDRF	**Recurring/ Regular** • Train professionals on how to handle slope failures and their remediation and landslide emergencies by promoting observational method of design and construction with training on the development of contingency plans • Support to SDRF, CDEF, community, and volunteers	DMD, State DGM, SRSAC, ATIs, SIRD SIDM, SLRTI	**Recurring/ Regular** • Support and collaboration to national agencies • Training and skill upgrades for search and rescue • Conduct regular training programmes for professionals including those for care and protection of disaster affected animals	As indicated in Table-7.12.
2	Curriculum Development	MoM, GSI, MHRD, UGC, AICTE, CoA, NIDM	**Medium Term (T2)** Review and revise curriculum	DMD, SDMA, EDD	**Medium Term (T2)** Include information on landslides and snow avalanches in the curriculum	
3	Awareness Generation	GSI, NIDM, NDMA, NDRF, CAPF, MoIB	**Recurring/ Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Promote use of insurance/ risk transfer • Promote Community Radio	DMD, SDMA, SDRF, F&ES, IPRD, DDMA, PRIs, ULBs, CDEF, Police	**Recurring/ Regular** • Carry out mass media campaigns • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns/ IEC • Promote use of insurance/ risk transfer • Promote Community Radio • Inform people about care and protection of disaster-affected animals	

4	Mock Drills/ Exercises	NDMA, All the concerned Government Ministries/ Agencies, NDRF, Armed Forces, CAPF	**Recurring/ Regular** • Promoting the planning and execution of emergency drills by all ministries and in all States/UTs	DMD, SDMA, SDRF, F&ES, CDEF, Police, DDMA, PRIs, ULBs	**Recurring/ Regular** Joint planning and execution of emergency drills	
5	Documentation	Nodal Agency: MoM-GSI in collaboration with the NIDM; CBRI; CRRI; MoST; BRO; IITs, universities, and other academic institutions	**Recurring/ Regular** Documenting the history of landslide studies and other related activities in India	DMD, SDMA, SIDM, ATI, SLRTI, DDMA, PRIs, ULBs	**Recurring/ Regular** Constitute multi-institutional and multi-disciplinary teams for carrying out post landslide field investigations, document the lessons learnt and disseminate	
6	Empowering women, marginalised, and persons with disabilities	MSJE*, MWCD, NDMA, NIDM	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management	DMD, SDMA SIDM, ATI, SLRTI, DDMA, PRIs, ULBs	**Recurring/ Regular** Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management at the state, district, and local levels	
7	Community-Based Disaster Management	NDMA, NIDM, MORD, MHUA	**Recurring/ Regular** Promotion, Guidance, and Support	DMD, SDMA DDMA, PRIs, ULBs	**Recurring/ Regular** • Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach • Training for PRIs, SHG, NCC, NSS, Youth, local community organizations	

Table-7.7.5: Climate Change Risk Management (Landslide and Snow Avalanche)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibilities of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Research, Forecasting / Early Warning, Data Management, Zoning, Mapping	MoM*, MoD*, MoES*, MoJS, MoAFW, DoS	**Recurring/ Continuous** • Assessment, Monitoring, and Scientific studies on GACC impacts on LSA **Short Term (T1)** • LSA vulnerability maps under GACC scenarios **Medium Term (T2)** • Study GACC-related changes on LSA • Prepare detailed scenario maps of LSA-prone areas likely to be impacted by GACC • Assess enhanced LSA risks from GACC • Develop database management system relating LSA, GACC and triggering events. **Long Term (T3)** • Improve the LSA forecasting capabilities consistent with the anticipated GACC impacts on flood- prone areas	DMD, IRD, WRD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Continuous** • Support national risk reduction efforts related to GACC • Coordination with central agencies **Short Term (T1)** • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Medium Term (T2)** • Document state-specific GACC impacts and coping mechanisms • Promote local weather-based insurance mechanisms and agricultural practices. **Long Term (T3)** • Promote state-specific studies on enhanced risks (economic, social, etc.) under different GACC impact scenarios • Promote research studies with State specific contexts on GACC and consequent changes in hazards	Support and Coordination
2	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MoM*, MoD*, NDMA, NIDM, MoJS, MoST, MSJE, NLRTI	**Medium Term (T2)** • Improve the understanding of the enhanced vulnerabilities of LSA- prone communities • Assess GACC risks of vulnerable and marginalised sections • Provide technical support and guidance for comprehensive HRVCA considering GACC impacts **Long Term (T3)** • Undertake detailed studies on vulnerability and risk due under GACC	DMD, SDMA, RD, IRD, DSJE, SLRTI	**Recurring / Continuous** • Undertake HRVCA as part of preparing and periodic revision of DM plans **Short Term (T1)** • Data Collection related to landslides **Short & Medium Term (T1, T2)** • Develop State specific strategies • Assess GACC risks of vulnerable and marginalised sections	Support and Coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibilities of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			scenarios for LSA-prone regions			
3.	Climate Change Adaptation (CCA)	MoM*, MoD*, MoES*, MoST, DoS, MoJS, MoEFCC	**Short Term (T1)** • Understanding adaptation needs **Medium Term (T2)** • Study coping mechanisms • Develop adaptation mechanisms **Long Term (T3)** • Implement adaptation programs and projects • Promote appropriate combinations of Green and Blue infrastructure approach • Promote adaptive measures in social protection programmes for the vulnerable groups	DMD, EFD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Continuous** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation **Short Term (T1)** • Develop local adaptation strategies and pilot projects **Medium Term (T2)** • Sponsor and promote state-specific efforts and local efforts **Long Term (T3)** • Implementation of GACC adaptation programs • Promote appropriate combinations of Green and Blue infrastructure approach • Integrate adaptive measures in social protection programmes for the vulnerable groups	Support and Coordination

7.8 Thunderstorm & Lightning, Squall, Dust Storm, and Strong Wind – The Responsibility Matrix

Table-7.8.1: Understanding Risk (Thunderstorm/Lightning/Squall/Dust Storm/Strong Wind)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Understanding Risk	MoES	**Recurring/ Regular (RR)** Technical support, data collection **Short Term (T1)** Compiling the baseline data of 2005-2015 **Medium Term (T2)** Guidelines and action plan	SDMA, DMD	**Recurring/ Regular (RR)** • Preparing State Action Plan and its implementation • Prepare detailed departmental SoPs by concerned department • Data Collection **Short Term (T1)** • Compiling the baseline data of 2005-2015	Support & Coordination

Table-7.8.2: Inter-Agency Coordination (Thunderstorm/Lightning/Squall/Dust Storm/Strong Wind)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1.	Inter-Agency Cordination	MOES*, MIB, DOT, **MoP**, MHA, MAFW MHA, NEC, NDMA	**Recurring/ Regular (RR)** • Early Warning and Communication • Alerts and weather forecasts • In case of forecasts/ warning of extreme /severe nature: Specific message and information, dissemination to public at large through print/ electronic and social media, SMS, etc. in relevant geographic area • Specific message dissemination to concerned Power Generation, Transmission, Distribution and Supply offices • Alertness and deployment of NDRF as per requirement • Monitoring and Review of the Guidelines • Technical support • Periodic review/ updating	DMD, SDMA, DDMA, IPRD, **PED***, AGD*	**Recurring/ Regular (RR)** • To disseminate the information received from IMD to public at large • Promote installations of lightning arresters and Doppler Radars • Create a network of community based early warning systems • Ensure specific message and information, dissemination to public at large through print/ electronic/ social and other mass media at local level • Ensure Push SMS by various telecom service operators to all active mobile connections • Activate all concerned DISCOM office/officers • **To ensure no power cuts and restoration of power supply and also provide emergency power supply to critical facilities** • Activate the district administration with line departments as soon as specific warning is received. • Following and quickly implementing the instructions of central/state govt. • Designate a nodal officer for emergency response • Institutionalised multi-agency coordination with clear role and responsibility • Rescue and evacuation operations in coordination with the administration, NGOs and volunteers. • Emergency medical response • Other necessary related actions • Nodal officer's act as the contact person for each dept. / agency • Monitor State/District level plan • Collect updated data / information and plan for review/updating	As indicated in Table-7.10. Control Rooms at Center/ Regional/ State to coordinate with Central /State Authorities and disseminate early warning signals at local control room level.

Table-7.8.3: Investing in DRR–Structural Measures (Thunderstorm/Lightning/Squall/Dust Storm/Strong Wind)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities	Important Norms /Standards
		Centre	Responsibility-Centre	State	Responsibility -State		
1	Hazard resistant construction, strengthening, and retrofitting of all power plant structures and critical infrastructure	MoP, BIS, CEA	**Recurring/ Regular** • Technical support and studies • Formulation of the guidelines / norms / standards.	Power Deptt., SDMA, DDMA	**Recurring/ Regular** Monitoring of adherence to the guidelines /norms / standards by the power utilities	**Recurring/ Regular** Adhere to the guidelines / norms / standards.	• The power plant structures are to be designed taking into account the wind loads and its effect on the structures as per the as per the IS 875 Part-III Code. • Wind design parameters have been averaged over a relatively long period of time and require a gust factor greater than 1.0 to be applied for design of structure, systems and components. • Protection against the lightweight panels can be provided by properly securing them with their supporting frames. • For the distribution networks, underground or ABC cables may be used in the potential thunderstorm/lightning, Dust /Hailstorm, Squall, and Strong Wind zones as far as possible. • For protecting the power establishment against lightning, installation of lightning arrestors and sound earthing for each building is essential.

Table-7.8.4: Capacity Development (Thunderstorm/Lightning/Squall/Dust Storm/Strong Wind)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Capacity Development	NIDM*,MoIB,NDRF, Other Ministries	**Recurring/ Regular (RR)** • Training programme for all concerned functionaries, SDRF, CDEF, community, and volunteers • Extensive IEC campaigns to create awareness through print, electronic and social media • Push SMS by various telecom service operators to all active mobile connections	DMD, SDMA, SDRF, SIRD, SLRTI, IPRD	**Recurring/ Regular (RR)** • Training programme for all concerned department officials/ volunteers, CDEF, community, and volunteers • Conduct training programmes and drills on usage of various fire protection equipment and preventive systems • Creation of public awareness • Extensive IEC campaigns to generate public awareness through print, electronic and social media • Ensure Push SMS by various telecom service operators to all active mobile connections.	As indicated in Table-7.12.

Table-7.8.5: Climate Change Risk Management (Thunderstorm/Lightning/Squall/Dust Storm/Strong Wind)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Climate Change Risk Management	NIDM*, MoIB, NDRF, Other Ministries	**Medium Term (T2)** • Promote research, monitoring and information systems consistent with the anticipated GACC impacts • Develop database management system relevant to climate change	DMD, SDMA, EFD, AGD, AHD, DRD, UDD, SLRTI, PRI, ULB, SPWD, SLRTI	**Recurring/ Regular (RR)** • Support and cooperate with central agencies • Sponsor state-specific efforts; support local efforts	Support and coordination
		MOES*, MAFW*, MOEFCC	**Short-Term (T1)** • Understanding GACC adaptation needs • Study GACC coping mechanisms • Develop GACC adaptation mechanisms **Medium & Long Term (T2, T3)** • Implement GACC adaptation programs • Promote adaptive measures in social protection programmes for the vulnerable groups	DMD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Regular (RR)** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state- specific efforts and local efforts for GACC mitigation and adaptation **Short -Term (T1)** Develop local adaptation strategies and pilot projects **Medium -Term (T2)** • Sponsor and promote state- specific efforts and local efforts • Implementation of GACC adaptation programs • Integrate adaptive measures in social protection programmes for the vulnerable groups	

7.9 Pandemic / Epidemic – The Responsibility Matrix

Table-7.9.1: Understanding Risk (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Observation Networks, Information Systems, Monitoring, Research, Forecasting, Early Warning and Zoning/ Mapping	MHFW(NCDC), MAFW, MHA, MOD, MOES, MOEFCC, MOR, MLBE, MEITY	**Recurring/ Regular (RR)** • Support for training • Extend technical support **Medium Term (T2)** • Establishment of Early Warning System • Strengthening IDSP and early warning systems at regional levels • Epidemiological disease mapping • Health facilities mapping	HFWD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI/ULB, SLRTI, DDMA	**Recurring/ Regular (RR)** Maintaining preventive measures as per norms **Short Term (T1)** Strengthening integrated health surveillance systems **Medium Term (T2)** • Establishing and maintain community-based network for sharing alerts • Strengthening IDSP **Long Term (T3)** States should, modify or adapt IMD's warning system according to thresholds applicable in each state	Support and coordination
2	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MHFW, MAFW, MHA, MOD, MOES, MOEFCC, MSJE, NDMA	**Recurring/ Regular (RR)** • Promote studies, documentation and research • Provide Training & Technical support • Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion and equity aspects **Short-Term (T1)** Develop guidelines	HFWD, DMD, SDMA, DRD, UDD, DWSD, EFD, AHD, WCD, DSJE, PRI, ULB, SLRTI, DDMA	**Recurring/ Regular (RR)** • Updating HRVCA • Identifying the vulnerable population/ communities/ settlements • Identification of groups requiring special attention • Conduct audit of equipment and human resource requirements **Short Term (T1)** • Constitute/ strengthen the mechanisms for consultation with experts and stakeholders	Support and coordination
3	Dissemination of warnings, data & information	MHFW, MHA, MOD, MOES, MAFW,	**Recurring/ Regular (RR)** • Support for organizing training	HFWD, DMD, SDMA,	**Short Term (T1)** • Create awareness preventive measures • Extensive IEC campaigns to create	Control Rooms at Center/

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
		MOEFCC, NDMA	• Extend technical support	DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI, ULB, SLRTI, DDMA	awareness through print, electronic and social media **Medium Term (T2)** Specific messages for highly vulnerable groups such as elderly, young children, outdoor workers and slum residents	Regional/ State to coordinate with Central /State Authorities and disseminate early warning signals at local control room level.
4	Disaster Data Collection and Management	MHA,MOSPI, all ministries/ depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	DMD, SDMA, all depts.	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline	**Recurring/ Regular (RR)** Systematic data management of data on disaster damage and loss assessments **Short Term (T1)** Disaster Damage and Losses 2005-2015 baseline

Table-7.9.2: Inter-Agency Coordination (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Overall disaster governance	MHFW, MHA, MOD, MOES, MAFW, MOEFCC, MOR, MLBE, NDMA	**Recurring/ Regular** • Preparing guidelines • Promote the mainstreaming of DRR in healthcare • Technical inputs for implementation based on experience from different locations • Collaboration with NGOs/CSOs	HFWD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI, ULB, DDMA	**Short Term (T1)** • Implementation as per specific conditions in the state • Team mobilization and coordination - officials and agencies • Involving local administration **Medium Term (T2)** • Coordinate with the state MOES (IMD) office regarding forecasts, early warning and alert system based on colour codes corresponding to different thresholds • Develop a clearly defined inter-agency emergency response plan with roles and information flows clearly marked out **Long Term (T3)** • Partnering local institutions with national institutions / experts • Adapting HAPs developed in other countries/cities, monitoring and evaluating implementation and impact on mortality and morbidity	As indicated in Table-7.10.
2	Preparation and Response	MHFW, MHA, MOD, MAFW, MOEFCC, MLBE	**Short Term (T1)** • Strengthening of integrated surveillance systems based on epidemiological surveys; detection and investigation of any disease outbreak. • Development of HEOC and its integration with centralized EOC • Developing specialized response capabilities for biological emergencies • Develop preparedness for biosafety issues relating animals and agricultural crops, especially food crops	HFWD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI, ULB, DDMA	**Short Term (T1**) • Rapid health assessment and provision of laboratory support • Institution of public health measures to deal with secondary emergencies as an outcome of biological emergencies	

3	Warnings, Information, Data	MHFW, MHA, MoD, MOES, MAFW, MOEFCC, MOR, MLBE, NDMA	**Short Term (T1)** • Public awareness and community outreach • Documentation • Collecting Data from States **Medium Term (T2)** • Collecting Data/ Information necessary for review/ update of the plan • Maintaining national-level database	HFWD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI/ULB, SLRTI, DDMA	**Short Term (T1)** • Follow the alerts/warning • "Do's-and-Don'ts" should be available in local languages and widely disseminated • Dissemination of warnings to all, down to the last mile — remote, rural or urban • Regular updates to people in areas at risk **Medium Term (T2)** Collecting Data/ Information necessary for review/ update of the plan	

Table-7.9.3: Investing in DRR – Structural Measures (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Strengthening Response	MHFW, MHA, MOD, MOES, MAFW, MOEFCC, NDMA	**Short Term (T1)** • Strengthening Pre-Hospital Care and Emergency Medical Care (EMC) Network • Identifying infrastructure needs for formulating mitigation plans • Laying down minimum standards for water, food, shelter, medical care, sanitation, and hygiene • Strengthening of EMT response mechanism nationally and internationally and IHR Framework	HFWD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD,	**Short Term (T1)** • Establishing adequate decontamination systems, critical care Intensive Care Units (ICUs) and isolation wards with pressure control and lamellar flow systems • Adequate Personal Protective Equipment (PPE) for all the health workers associated with the responding to biological emergencies **Medium Term (T2)** • Strengthening/mainstreaming the network medical assistance facilities • Equipping Medical First Responders (MFRs)/Quick Reaction Medical Teams (QRMTs) with all material logistics and backup support **Long Term (T3)** • Upgradation of earmarked hospitals to cope with Chemical, Biological, Radiological and Nuclear (CBRN) emergencies • Communication and networking system with appropriate intra-hospital and inter-linkages with state ambulance/transport services, state police departments and other emergency services • Mobile tele-health services and Mobile Hospitals	**Recurring/ Regular** Support and coordination

2.	Upgrading Medical Facilities	MHFW, MHA, MOD	**Medium Term (T2)** Guidelines and technical support Specialized health care and laboratory facilities **Long Term (T3)** • Creating a chain of public health laboratories with at least one such laboratory in each district • Stockpiling of essential medical supplies such as vaccines and antibiotics, etc. • Guidance for establishing and strengthening quarantine facilities	HFWD, DMD, SDMA, DRD, UDD, WCD, PRI, ULB, DDMA	**Medium Term (T2)** Specialized health care and laboratory facilities to address biological emergencies/ incidents **Long Term (T3)** • Establishing and strengthening quarantine facilities • Creating at least one public health laboratory in each district	Support and coordination

Table-7.9.4: Investing in DRR – Non Structural Measures (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Utilities
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Techno -Legal regimes	MHFW, MHA, MOD, MAFW, NDMA	**Recurring/ Regular (RR)** Guidance and Support **Medium Term (T2)** • Dovetail norms and regulations relevant for BPHE with the DM Act 2005 • Enact/ amend any Act, Rule or Regulation, if necessary, for better implementation of BPHE programmes	HD, DMD, SDMA, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI, ULB, DDMA	**Recurring/ Regular (RR)** Strengthen institutional arrangements **Medium Term (T2)** Enact/ amend any Act, Rule or Regulation, if necessary, for better implementation of BPHE programmes	**Recurring/ Regular** Adhere to the guidelines / norms / standards.
2.	Biosafety and Biosecurity Measures and Environmental Management	MHFW, MHA, MOD, MOES, MAFW, MOEFCC	**Recurring/ Regular (RR)** • Strict compliance with biosafety and biosecurity provisions • Environmental monitoring to prevent outbreaks • Integrated vector management for elimination of breeding places • Biological and chemical interventions for vector control • Monitoring of water supply and sewage systems to prevent the dispersal of biological agents that can cause epidemics	HD, DMD , SDMA, AHD, PRI, ULB, SLRTI, DDMA	**Recurring/ Regular (RR)** • Strict compliance with biosafety and biosecurity provisions • Environmental monitoring to prevent outbreaks	**Recurring/ Regular** Adhere to the guidelines / norms / standards.
3	Risk Transfer	MFIN, NDMA, MHA, MAFW	**Recurring/ Regular (RR)** Implementation of Risk Transfer Arrangements including multi-hazard insurance for life and property **Short Term (T1)** Policy Framework	DFIN, DMD , SDMA, DAG	**Recurring/ Regular (RR)** Implementation of Risk Transfer Arrangements including multi-hazard insurance for life and property **Short Term (T1)** Policy Framework	**Recurring/ Regular** Adhere to the guidelines / norms / standards.

Table-7.9.5: Capacity Development (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1	Human Resource Development & Training	MHFW, MHA, NDRF, MOD, AYUSH, MOES, MAFW, MOEFCC, NIDM, MoYAS	**Recurring/ Regular (RR)** Training support for SDRF, CDEF, community, and volunteers **Medium Term (T2)** Strengthening of National Disaster Response Force (NDRF), medical first responders, medical professionals, paramedics and other emergency responders **Long Term (T3)** • Development of human resources for monitoring and management of the delayed effects of BPHE in the areas of mental health and psychosocial care • Training programmes in the areas of emergency medicine and biological emergency management for hospital administrators, specialists, medical officers, nurses and other health care workers • Training for youth through NCC, NYKS, Scouts and Guides and NSS	HFWD, DMD , SDMA, SDRF, RD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI, ULB, SIRD, SLRTI, DDMA	**Recurring/ Regular (RR)** Training support for CDEF, community, and volunteers **Medium Term (T2)** • Training for surveillance • Training for deployment of Rapid Medical Response Teams • Training for All Health and allied healthcare professions, AYUSH doctors and practitioners, community health workers, ASHA, MPWS, ANM and aanganwadi workers. **Long Term (T3)** Organising community awareness programmes for first aid and general triage	As indicated in Table-7.12.
2	Knowledge management & Curriculum Development	MHFW", MOD, MOES, MAFW, MOEFCC, MHRD, NIDM	**Recurring/ Regular (RR)** • Incorporating basic knowledge of BPHE management through the educational curricula • Support for proper education and training health emergency personnel • Promote continuing medical education programmes and workshops at regular intervals • Defining the role of public, private, and corporate sector for their active	HFWD, DMD, DRD, UDD, EDD, EFD, AHD, SLRTI, PRI, ULB, DDMA	**Recurring/ Regular (RR)** • Incorporating basic knowledge of BPHE management through the educational curricula • Proper education and training of personnel • Conduct continuing medical education programmes and workshops at regular intervals • Defining the role of public, private, and corporate sector for their active participation and their sensitisation	

			participation and their sensitisation			
3	Awareness Generation	MHFW", MOES, MAFW, MOEFCC, MLBE, NDMA, MOIB, NIDM	**Recurring/ Regular (RR)** • Support awareness campaigns/ IEC • Support network of civil society organizations for awareness generation about emergencies caused by biological agents	HFWD, DMD, SDMA, IPRD, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI/ULB ,SLRTI, SIHFW, DDMA	**Recurring/ Regular (RR)** • Promoting awareness, alertness and preparedness • Training programs for public, PRIs/ ULBs • Community awareness programme for first aid • Dos and Don'ts to mitigate the effects of medical emergencies caused by biological agents • Awareness about the importance of personal hygiene • With due consideration to the social, ethnic and religious issues involved, utmost care will be exercised in the disposal of dead bodies.	
4	Mock Drills/ Exercises/ CBDM	MHA, MHFW, MOD, MAFW, MOEFCC, MOR, NDMA, NRDF	**Recurring/ Regular (RR)** • Promoting the planning and execution of emergency drills • Technical support for identifying and resolve communication gaps between participating departments, partners and the public	HFWD, DMD, SDMA, EFD, RD, DDMA, SDRF, F&ES, CDEF, Police, PRI, ULB	**Recurring/ Regular (RR)** • Defining the role of the community as a part of the disaster management • Testing of various elements of the hospital emergency preparedness through table top exercises, and mock drills • Identify and resolve communication gaps between participating departments, partners and the public • Joint execution of emergency drills with local bodies	
5	Hospital Preparedness	MHFW, MHA, MOD, MLBE	**Short Term (T1)** • Identifying, stockpiling, supply chain and inventory management of drugs, equipment and consumables including • vaccines and other agents for protection, • detection, and medical management **Medium Term (T3)** • Institutionalisation of advanced Emergency Medical Response System (EMRS) • Upgrading existing biosafety laboratories and establishing new ones	HFWD, DMD , SDMA, DRD, UDD, DWSD, WCD, DDMA	**Recurring/ Regular (RR)** Preparation of DMP by all the hospitals including those in the private sector **Medium Term (T2)** Developing a mechanism to augment surge capacities to respond to any mass casualty event following a biological emergency **Long Term (T3)** Specialised health care and laboratory facilities	

6	Applied research	MHFW", MOD, MOES, MAFW, MOEFCC, MOST	**Recurring/ Regular (RR)** Post-disaster phase medical documentation procedures and epidemiological surveys **Short Term (T1)** Regular updating by adopting activities in Research and Development (R&D) mode, initially by pilot studies **Medium Term (T2)** Development of post-disaster medical documentation procedures and epidemiological surveys **Long Term (T3)** Strengthening of scientific and technical institutions for knowledge management and applied research and training in management of CBRN emergencies	HFWD, DMD, SDMA, DRD, UDD, DWSD, EDD, PD, EFD, AHD, WCD, PRI/ULB, SLRTI	**Long Term (T3)** Strengthening of scientific and technical institutions for knowledge management and applied research and training in management of CBRN emergencies	
7	Empowering women, marginalised communities, SC/ST, and persons with disabilities	MHFW, MHA, NIDM, NDMA	**Recurring/ Regular (RR)** • Guidance • Promote gender sensitive and equitable approaches	WCD, HFWD, DMD, SDMA, DRD, UDD, PRI, ULB, DDMA	**Recurring/ Regular (RR)** Incorporating gender sensitive and equitable approaches in capacity development for coping with BPHE	

Table-7.9.6: Climate Change Risk Management (Pandemic / Epidemic)

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
1.	Research, Forecasting, Early Warning, Data Management, Zoning, Mapping	MHFW, MOES, MOEFCC, MOES, NDMA, NLRTI	**Recurring/ Regular (RR)** Share information and updates **Short Term (T1)** Strengthening integrated health surveillance systems based on GACC scenarios **Medium Term (T2)** • Detailed assessment and monitoring of biological threats under GACC impact scenarios • Develop Database management system relating to Biological Disasters & climate change **Long Term (T3)** Improve forecasting and assessment capabilities consistent with the anticipated changes	HFWD, DMD, SDMA, DRD, UDD, AGD, DWSD, EDD, PD, EFD, AHD, SLRTI	**Recurring/ Regular (RR)** • Support and cooperate with central agencies • Sponsor and support state-specific and local efforts	Support and coordination
2.	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	MHFW, MOES, MAFW*, MOEFCC, NDMA, MSJE, NLRTI	**Medium & Long Term (T2, T3)** • Undertake detailed studies on vulnerability and risk under GACC scenarios • Assess GACC risks of vulnerable and marginalised sections • Provide technical support and guidance for comprehensive HRVCA considering GACC impacts	HFWD, DM, SDMA, AGD, RD, WRD, DSJE, SLRTI	**Recurring/ Regular (RR)** Undertake HRVCA as part of preparing and periodic revision of DM plans **Medium Term (T2)** Assess GACC risks of vulnerable and marginalised sections	Support and coordination
3.	Climate Change Adaptation (CCA)	MHFW, MOES, MOJS, MOEFCC, MAFW	**Short-Term (T1)** • Understanding adaptation needs • Study coping mechanisms • Develop adaptation mechanisms **Medium & Long Term (T2, T3)** • Environmental monitoring to reduce risks from GACC • Support the implementation of CCA programs • Promote appropriate combinations of	HFWD, DMD, SDMA, DDMA, PRIs, ULBs	**Recurring/ Regular (RR)** • Sensitisation and awareness creation • Support national CCA efforts • Coordination with central agencies • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation	Support and coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities				Responsibility of Power Sector
		Centre	Responsibility-Centre	State	Responsibility -State	
			Green and Blue infrastructure approach • Promote adaptive measures in social protection programmes for the vulnerable groups		**Short —Term (T1)** Develop local adaptation strategies and pilot projects **Medium -Term (T2)** Sponsor and promote state- specific efforts and local efforts **Long — Term (T3)** • Implementation of GACC adaptation programs • Promote appropriate combinations of Green and Blue infrastructure approach • Integrate adaptive measures in • social protection programmes • for the vulnerable groups	

Table-7.10: Inter-Agency Coordination

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities			
		Centre	Responsibility-Centre	State	Responsibility -State
1	Overall disaster governance	MoP, CEA, NLDC, CPSUs	**Recurring/ Regular** • Preparation of Disaster Management Plan for Power Sector. • Ensure that all CPSUs prepare their own DMP. • Providing coordination, technical inputs, and support • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development	RPC, SLDC, STU, Power Deptt., Gencos , Discoms	**Recurring/ Regular** • Preparation and implementation of DM plans. • All aspects of disaster risk management and mainstreaming DRR • Ensuring coherence and mutual reinforcement of DRR, CCA and development
2	Response	MoP, NLDC, RLDC	**Recurring/ Regular** • Organizing and coordinating central assistance	SLDC, STU, Power Deptt. Gencos, Discoms	**Recurring/ Regular** • Organizing and coordinating the immediate response • Coordinate with central agencies
3	Warnings, Information, Data	MoP, NLDC, RLDC CPSUs	**Recurring/ Regular** • Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data	SLDC, STU, Power Deptt. Gencos, Discoms	**Recurring/ Regular** • Coordinating the dissemination of warnings to all, down to the last mile – remote, rural or urban; Regular updates to people in areas at risk
4	Non-structural measures	MoP, CEA, CERC	**Recurring/ Regular** • Coordination among central and state agencies for a) revised/ updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/ review policies	SERC, SLDC, Power Deptt.	**Recurring/ Regular** • Coordination among state agencies for ensuring updated norms/ codes and their implementation, enforcement and monitoring

Table-7.11: Investing in DRR – Non- Structural Measures

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities			
		Centre	Responsibility-Centre	State	Responsibility -State
1	• Laws • Regulations • Enforcement Mechanisms. • Techno-Legal regimes • Institutional Arrangements • Codes for disaster risk reduction • Compliance monitoring.	MoP, CEA, RPCs CERC, CPSUs, NLDC, RLDCs	**Recurring/ Regular** • Preparation of Regulations and Technical Standard for construction and operation of Power Plants, Transmission System, Distribution System and Load Despatch Centres. • Compliance and Enforcement of the regulations, guidelines and codes to be ensured.	SERC, SLDC, STU, Gencos, Discoms, Power Deptt.	**Recurring/ Regular** • May adopt the regulations of centre or prepare its own codes and standard in consonance with centre. • Coordination with RLDCs, RPCs, CEA for compliance and enforcement.

Table-7.12: Capacity Development

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities			
		Centre	Responsibility-Centre	State	Responsibility -State
1	Training programs	MoP, CEA, CPSUs, NLDC, RLDCs, NPTI, CPRI	**Recurring/ Regular** • To conduct workshops, seminars and conferences for capacity building for Disaster Risk Reduction in different organizations of power sector.	Power Deptt., SLDC, STU, Gencos , Discoms	**Recurring/ Regular** • To conduct workshops, seminars and conferences for capacity building for Disaster Risk Reduction or to follow the capacity development program adopted at the central level and participate in these programmes.
2	Curriculum Development	CEA, NPTI	**Medium Term (T2)** • To prepare the short-term courses on different aspects of Disaster Risk Reduction for power utilities. NIDM may also be roped in for this.	Power Deptt., SLDC, STU, Gencos , Discoms	**Medium Term (T2)** • To prepare their own short-term courses on different aspects of Disaster Risk Reduction for power utilities or follow the central curriculum.
3	Awareness Generation	MoP, CEA, CPSUs, NLDC, RLDCs, NPTI, CPRI	**Recurring/ Regular** • Carry out campaigns at individual plant level for Strengthening awareness about DRR and DM • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns • Pamphlets and booklets containing details Dos & Don'ts in the event of emergency situations and hazards associated with electricity infrastructure viz. generating stations, sub-station, transmission system be prepared and be made available to the general public. • Permanent notice boards be fixed at all the suitable places in the area displaying information maps, escape routes, precautions to be taken and emergency communication details of nodal officers. • Help from local youth organizations, voluntary organizations, educational institutions be sought to	Power Deptt., SLDC, STU, Gencos , Discoms	**Recurring/ Regular** • Carry out campaigns at individual plant level for Strengthening awareness about DRR and DM • Promote culture of disaster risk prevention, mitigation, and better risk management • Promote attitude and behaviour change in the awareness campaigns • Pamphlets and booklets containing details Dos & Don'ts in the event of emergency situations and hazards associated with electricity infrastructure viz. generating stations, sub-station, transmission system be prepared and be made available to the general public. • Permanent notice boards be fixed at all the suitable places in the area displaying information maps, escape routes, precautions to be taken and emergency

Sl. No.	Major Theme	Central/State Agencies and their Responsibilities			
		Centre	Responsibility-Centre	State	Responsibility -State
			conduct an educational session to make people aware of the safety measures and rescue operations in the event of a disaster.		communication details of nodal officers. • Help from local youth organizations, voluntary organizations, educational institutions be sought to conduct an educational session to make people aware of the safety measures and rescue operations in the event of a disaster.
4	Mock Drills/ Exercises	CEA,CPSUs, NLDC, RLDCs,	**Recurring/ Regular** • Carry out comprehensive drills periodically (at least once every three months) to test capabilities. Emergency scenarios shall be developed to test the emergency plans and operational response at all levels through mock drill exercises. At the end of each exercise, an evaluation shall be carried out to identify and take care of any deficiency. • Promoting the planning and execution of emergency drills • Share the copy of Mock Drill with CEA/MoP.	SLDC, STU, Gencos , Discoms, Power Deptt.,	**Recurring/ Regular** • Carry out comprehensive drills periodically (at least once every three months) to test capabilities. Emergency scenarios shall be developed to test the emergency plans and operational response at all levels through mock drill exercises. At the end of each exercise, an evaluation shall be carried out to identify and take care of any deficiency. • Promoting the planning and execution of emergency drills • Share the copy of Mock Drill with CEA/SLDC
5	Empowering women, and persons with disabilities	CPSUs	**Recurring/ Regular** • Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management	Power Deptt., STU, Gencos , Discoms	**Recurring/ Regular** • Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management.

Notes:

(#) Every ministry, department or agency of the government – central and state – not specifically mentioned has both direct and indirect supporting roles depending on the disaster, location and context.

(*) The ministry, department or agency with this symbol has or is deemed to have a nodal or lead role, while others mentioned have a direct or explicit supporting role.

Chapter-8

8. Preparedness and Response

8.1 Preparedness

UNDRR defines preparedness as –

> "*The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions*".

Preparedness covers activities and measures taken in advance to ensure an effective response to the impact of hazards, including issuance of timely and effective early warnings and temporary evacuation of people and property from the threatened location. It aims at building the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery.

Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems and includes activities such as contingency planning, stockpiling of equipment and supplies, development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities.

For effective preparedness to face disasters and to avoid last-minute arrangements in panic conditions, the following aspects shall be covered as an organizational practice:

a) Well-documented emergency plans.
b) Data on the availability of resources and buffer stock of restoration materials.
c) Identification of key personnel with their skills and experience in disaster management.
d) Allocation of budget for emergencies.
e) Delegation of power at various levels for disaster conditions.
f) Mutual assistance agreements signed by all power utilities for sharing men and material resources on demand.
g) Alternative failsafe Communication system due to failure of conventional communication system.
h) Plan for using outsourced manpower, services etc.

8.1.1 Other Preparedness Aspects Specific for Power Sector:

a) Safety and security audits must be carried out at each generating station and substation on a yearly basis.
b) Fire alarm and fire extinguishing systems must be checked regularly for their healthiness and regular drill should be carried out for their operation by involving the officers and staff of the concerned Unit so that they also know how to operate the system.
c) The islanding schemes (electricity grid) of each state must be updated on a continuous basis in consultations with the Regional Power Committee.
d) Each Regional Power Committee/Regional Load Despatch Centre/State Load Despatch Center must identify all the generating stations/grid sub-stations and load despatch centres according to their critical importance with respect to safe operation of the electricity grid. The highest critical station must be provided the highest security arrangement and it may go on reducing to the least risk element, without jeopardizing safety of the electricity grid.
e) Underground power houses should be provided with exit routes at different locations and these exit routes need to be displayed for the staff working in the power house to come out in case of any emergency like flooding etc. Smoke evacuation systems should also be provided in underground power stations.
f) Control Strategies - Control strategies cover dos and don'ts, well laid Standard Operating Procedures (SOPs) and defined action plans in the wake of emergency situations although the plan is subject to variation due to various types and intensities of disaster. It should be designed to mitigate and control consequences due to any disaster. Standard Operating Procedures should be devised for organizing safe shutting down of the plant/substation if required and isolating remaining plant/substation and keeping it in a safe condition to save assets & lives and minimize the damage so that quick recovery would be possible once disaster is over.
g) All-State and Central power utilities shall constantly review the equipment/system design standards and practices based on the new developments and the state of art technologies and design practices available at that time. The equipment which frequently creates problems should be replaced.
h) Each power utility shall create a fund for meeting the requirement of the disaster management plan. The disaster management fund would be 1.5% of the annual revenue of the utility. Besides the above, every utility should have a core corpus of sufficient amount especially for immediate relief and rehabilitation depending upon revenue potential of the utility and the same should be replenished on an annual basis.

i) Carry out comprehensive state wide drills periodically (at least once every three months) to test capabilities. Emergency scenarios shall be developed to test the emergency plans and operational response at all levels through mock drill exercises. At the end of each exercise, an evaluation shall be carried out to identify and take care of any deficiency.

j) There should be interaction on a continuous basis between various disaster management groups.

Box-8.1: Preparedness aspects to face disasters effectively:

- Well-documented emergency plans.
- Data on the availability of resources and buffer stock of restoration materials.
- Identification of key personnel with their skills and experience of disaster management.
- Allocation of budget for emergencies.
- Delegation of power at various levels for disaster conditions.
- Mutual assistance agreements signed by all power utilities for sharing men and material resources on demand.
- Alternative failsafe Communication system due to failure of conventional communication system.
- Plan for using outsourced manpower, services etc.

8.2 Response

Response measures are those taken immediately after receiving an early warning from the relevant authority or in anticipation of an impending disaster, or immediately after the occurrence of an event without any warning. The primary goal of response to a disaster is saving lives, protecting property, environment, and meeting basic needs of humans and other living beings after the disaster. The UNDRR (2016) defines response as:

> *"Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected".*

Response includes not only those activities that directly address the immediate needs, such as a warning to vulnerable populations, evacuation to avoid further damages, search and rescue, restoration of key infrastructure etc. but also the rapid mobilization of various systems necessary to coordinate and support the efforts. These activities are immediately initiated by the community itself and then by the district, state, national or up to international levels. The recovery, on the other hand, covers immediate restoration to long-term betterment reconstruction.

Disaster response is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. Effective, efficient and timely response relies on disaster risk-informed preparedness measures, including development of the response capacities of individuals, communities, organizations, countries and international communities. The institutional elements of response often include provision of emergency services and public assistance by public / private / community sectors, as well as community and volunteer participation.

Response is considered as the most visible among various phases of disaster management. The response process begins as soon as it becomes apparent that a disastrous event is imminent and lasts until the disaster is declared to be over. For effective response, all the stakeholders need to have a clear vision about hazards, its consequences, clarity on plans of action and must be well versed with their roles and responsibilities. The commonly associated measures involved in the response stages of power sector are outlined below and explained in succeeding paragraphs.

- First Information/Perceive the threat/Assess the hazard.
- Deployment of human resources.
- Deployment of essential resources such as equipment, spare parts and other material.
- Control Strategies - Dos and don'ts, Standard Operating Procedures(SOPs).
- Electricity Grid Restoration.
- Media Management.

8.2.1 First Information/ Perceiving the threat/Assess the hazard

Strategies for disaster management are very much based on information. As such, it is important to formulate and activate proper information and warning systems. The first source of information may be a local operator's observation or message from state/central government agencies/authorities.

A trigger mechanism must be established in the Disaster Management Plan to initiate action as soon as information is received from any person or organization in respect of any calamity which is likely to occur or has occurred. The information should immediately reach the Emergency Management Group through a chain of command that should be made known to all the key personnel in the organization such as Head of Technical Services, Head of internal security, Head of safety. Chief Medical Officer, Deputy Commandant (Security Services), Inspector (Fire), Engineer-in-charge of Transport (Auto Base), Head of materials, Head of HR & Head of Finance. A list of key personnel along with their communication details shall be informed to all concerned. An illustrative checklist of who has to do what is required to be prepared by each organization for its every station, in case of emergency.

The Emergency Management Group (EMG), depending upon the nature of the emergency is required to take the following actions:

a) Pre-alert Notification: This type of notification is mainly used for disseminating an important piece of information concerning slowly developing emergencies which can either be rectified or would take some time before they turn into a disaster.
b) Alert Notification: An alert notification implies that although a disaster is not imminent, aggravation of the situation could lead to disaster unless condition improves. Therefore, local officials should be alerted that an unsafe situation is developing.
c) Warning Notification: A warning notification implies that a disaster is imminent; and advance action may be initiated for minimizing the damages/ rescue operations. The warning notification, indicating the magnitude of disaster should be communicated to other power establishment in the region. In case of hydropower projects, it should also be communicated to the authorities concerned with the important structures located on the downstream stretches of the river.
d) Notification Responsibility: In case of developing a disaster situation, the project authorities shall be responsible for issuing a proper notification to District/ State/ Central level agencies, depending upon the severity of the disaster.

After receipt of information regarding any impending disaster, assessment of hazard & its impact on the electrical system should be done to prepare disaster management strategies better such as identification of vulnerable installations, deployment of resources, prevention & protection plan and quick restoration.

8.2.2 Deployment of Human Resources

Essential Staff

In power projects, immediately affected or likely to be affected as decided by the EMG, efforts shall be made to shut it down and make the process units safe. This work shall be carried out by the power project supervisors and essential operators. It will also be the responsibility of the EMG to remove all non-essential staff to assembly points.

EMG should identify the essential staff and form a Task force that reports at defined locations so that they can be readily contacted. It would also be desirable to form certain teams at the local level who could be given specific responsibilities required to be carried out, as detailed below.

Responsibilities of Teams

Task Force

a) Identify the source of hazard and try to neutralize/contain it.
b) Isolate remaining establishments and keep them in a safe condition.
c) Organize safe shutdown of the project, if necessary.
d) Organize all support services like operation of fire water pumps, sprinkler systems etc.
e) Any other responsibility as decided by Team Leader, looking into the circumstances at the time of the disaster.

Maintenance Team

a) Attend to all emergency maintenance jobs on a priority basis.
b) Take steps to contain or reduce level of hazard that can create a disaster.
c) Organize additional facilities as required.
d) Any other responsibility as decided by Team leader, looking into the circumstances at the time of the disaster.

Security Team

a) Man all the gates.
b) Bar entry of unauthorized persons and non-essential staff.
c) Permit entry of all authorized personnel and outside agencies, vehicles, etc. who have to provide assistance with minimum delay.
d) Allow ambulances/evacuation vehicles on a priority basis.
e) Any other responsibility as decided by Team leader, looking into the circumstances at the time of the disaster.

Administrative team

a) Rescue casualties on a priority basis.
b) Transport casualties to first aid posts, safe places or medical centres.
c) Account for personnel.
d) Help in the search for missing personnel.
e) Pass information to the kith and kin of fatal and injured persons.
f) Any other responsibility as decided by Team leader, looking into the circumstances at the time of disaster.

Safety team

a) Arrange required safety requirements.
b) Arrange to measure polluted gas concentration in case of gas leaks at various locations.

c) Collect and preserve evidence in connection with the accident, guide authorities on all safety-related issues.
d) Any other responsibility as decided by Team Leader, looking into the circumstances at the time of disaster.

Medical team

a) Arrange first aid material/stretcher and reach the accident site quickly.
b) Arrange for immediate medical attention.
c) Arrange for sending the casualties to various hospitals and nursing homes etc.
d) Ask specific medical assistance from outside including through medical specialists.
e) Any other responsibility as decided by Team Leader, looking into the circumstances at the time of the disaster.

Fire Fighting Team

a) Rush to the fire spot to extinguish fire.
b) Seek help from external firefighting agencies as required.
c) Evacuate persons affected due to whatsoever reasons.
d) Any other responsibility as decided by Team leader, looking into the circumstances at the time of disaster.

Auto Base Team

a) Make the whole auto base vehicles ready to proceed for evacuation or other duties when asked for.
b) Send at least one mechanic to the site of incidence where he may help in attending minor defects in an ambulance, fire renders or other vehicles.
c) Arrange petrol/diesel supply.
d) Make all arrangements regarding transportation.
e) Any other responsibility as decided by Team leader, looking into the circumstance at the time of disaster.

Communication Team

a) Maintain the communication network in working condition.
b) Attend repairs in the communication system urgently, if required.
c) Any other responsibility as decided by Team Leader, looking into the circumstances at the time of disaster.

Support Teams

Head of Personnel:

a) Contact statutory authorities.
b) Arrange for relievers and catering facilities.
c) Give information to media.
d) Arrange shelters for affected in medical centres nursing homes etc.

Head of Material:

a) Arrange for urgently required materials through cash purchase or whatever means.
b) Any other responsibility given by Station in-charge.

Head of Finance

a) Arrange for funds for various relief measures as well as emergency purchase of materials, sending his representative for emergency purchases.
b) Any other responsibility given by station in-charge.

Essential Services team

a) Maintaining continuous supplies of food, medicines etc.
b) Liaison with District Authorities for necessary assistance.
c) Making emergency arrangements.
d) Keeping station in-charge fully informed about the latest situation on maintenance of emergency arrangements.
e) Provision of facilities like rest/ sleep, daily needs etc. in the premises.

8.2.3 Deployment of Essential Resources

Communication Facilities

Communication and information management is the key to any disaster response and recovery plan. Use of modern-day information technology has to play a greater role in incorporating risk assessment, creating procedures, establishing command & control structure and monitoring disaster response activities. Use of the satellite communication system can be effectively made to coordinate the activities of various agencies involved in the relief and restoration work and expedite restoration of normalcy in the shortest possible time.

Alternative Communication arrangements, independent of power line communication and normal telephone, should be provided as such communication means are likely to be disconnected during natural calamities. These arrangements should be in the form of wireless links. Power projects should have walkie-talkie sets of appropriate capacity to cover the farthest point of the installation for effective communication. Modern technology like drones may also be used for faster

response. Each project should have few vehicles with public address system, which can be used to make necessary announcements. Similarly, the main gate/ gates may also have public address facilities for making an announcement.

Lighting

Emergency lights, DC operated inverters and diesel generators must be arranged for providing relief when the power supply gets affected both in a normal or disaster situation.

Recovery Equipment and Spares Inventory

In case of any disaster, it is necessary to have an inventory of recovery equipment and spares available with various power utilities so that these could be pressed into service within the shortest possible time. The overall inventory management system should be digitalized at each level. At national and also at state levels, e-portals should be developed for managing & sharing inventory of spare/restoration equipment required during an eventuality to reduce overall response time for restoration.

CEA has issued "Guidelines for availability of Spares and Inventories for Power Transmission System (Transmission Lines & Substation/Switchyard) Assets" and "Advisory on Spare Parts Management in Thermal Power Plants" that needs to be followed by the power utilities.

Transport and Other Arrangements

Arrangements for an adequate number of vehicles for movement of people and materials must be ensured and medical facilities around the clock shall be made available. Arrangements for drinking water supply must also be ensured.

Black Start Facilities

Arrangements for a start-up power source for each major installation must be identified. From the point of view of quick restoration of the system, it is necessary that sufficient Black Start resources are available and those are spread out uniformly throughout the country. This would obviate the need for charging long line sections for start-up supply. Regional Load Despatch Centres have to make necessary plans for this.

De-watering Pumps

During floods, the immediate concern is to minimize the impact of flood water on generators and other equipment. Availability of de-watering pumps is, therefore, considered necessary for stations located in flood-prone areas.

Mobile DG sets

A sufficient number of mobile DG sets should be available and should be moved immediately to provide emergency relief and for operating the dewatering pumps.

Solar Energy Systems and Photovoltaic Systems

Renewable energy sources can play an important role in reducing the exposure to risks of natural disasters and in speedy recovery because distributed renewable energy power systems are much less prone to being knocked out of service from a single catastrophic natural disaster than centralized power systems.

Solar energy systems and photovoltaic systems are particularly viable and suitable during the initial periods of disaster. Renewable energy sources are of great use for homes, businesses and institutions that are required to be accessible during blackout periods. These non-conventional sources of energy can be easily disassembled before the disaster strikes/hits and then placed back again once it passes. Woody debris created by storms, hurricanes and floods could be used for generating valuable power through a portable biogas unit.

List of Contractors

The local project authorities of disaster-prone areas should keep a list of competent contractors/agencies who can be assigned various components of restoration activities in the event of a disaster.

8.2.4 Control Strategies

The pre-defined control strategies such as dos and don'ts, Standard Operating Procedures (SOPs) as per the applicability to the specific disaster should be initiated immediately in the wake of emergency situations. The plant/substation should be shut down if required and the remaining plant/substation should be isolated as per SOPs to keep them in a safe condition for saving assets & lives and for minimizing damage.

8.2.5 Electricity Grid restoration

Grid Operation in India

Grid Controller of India Limited (Grid – India) erstwhile Power System Operation Corporation Limited (POSOCO) was formed in March 2010 to handle the grid management functions. It consists of five Regional Load Despatch centres (RLDCs) and a National Load Despatch centre (NLDC). Grid – India is responsible to ensure integrated operation of State, Regional and National Power Systems to facilitate the transfer of electric power within and across the states, regions and transnational exchange of power with Reliability, Security and Economy.

NLDC is the apex body to ensure integrated operation of National electricity grid. The country is demarcated into five synchronized regional grids namely North, West, East, Northeast and South. All five regional grids are operating in a synchronous mode, which implies that the power across these regions can flow seamlessly as per relative load generation balance. Each of the five regions has a RLDC, which is the apex body in their respective region to ensure integrated operation of the power system in the concerned region. The RLDCs for North, West, South, East and Northeast regions are located at Delhi, Mumbai, Bengaluru, Kolkata and Shillong respectively. RLDCs coordinate amongst themselves, offline as well as online, for maintaining security and stability of the integrated pan India grid. In line with the federal structure of governance in the country, every state has a State Load Despatch Centre (SLDC), which is the apex body to ensure integrated operation of the power system in the state.

Restoration Plan for Failure of Electricity Grid

Integrated operation of National Grid (all-India grid) is a vast and complex task and demands utmost vigil and care from the viewpoint of disaster management. In the event of a grid failure, coordinated actions are required to be taken at the generation stations, substations and transmission lines under the directions of NLDC/RLDC(s) and SLDC(s) for speedy restoration of power supply. Black Start/restoration procedures are already available in each region as well as in NLDC for use in the event of partial/complete failure of the grid identifying *inter-alia* the start-up power availability and restoration procedures.

Measures for Quick Restoration of Power Supply

The following measures are essentially required for quick restoration of power supply after a blackout:

a) Preparation of Black Start procedure by RLDCS/SLDCs in compliance with Grid Code.
b) The start-up procedure for generating units should be available in control room and shift duty personnel/ working-level personnel should be familiar with the procedure and they should start the machines (other than technical and safety issues of the machine) as per the direction given by SLDC/RLDC.
c) Shift duty personnel should remain present till the restoration process is completed before handing over charge to the next shift.
d) Survival / Auxiliary / Start-up power should be provided on a priority basis to the collapsed system and power should be utilized for other purposes only after meeting these power requirements.
e) Priority should be accorded in restoration as under:

- The main priorities are to restore power supply to the generating stations and load dispatch centres, formation of self-sustaining islands around the generating stations.
- Extending power for synchronizing islanded nuclear power stations or survival/start-up power to nuclear power plants.
- Extending start-up power to thermal power plants.
- Extending start-up power to non-self-starting hydro power plants.
- Restoration of traction power supply.
- Building up subsystems and synchronizing with each other.
- Restoration of supply to other essential loads such as mines, Hospitals etc.
- Restoration of supply to all other customers.
- Restoration of supply to communication system nodes and repeater stations.
- Formation of self-sustaining islands around the generating station as per laid down procedure:
    - Area Load Despatch concept should be adopted during start-up to avoid jamming of the communication system.
    - A list of contact numbers of all the sub-stations with STD codes should be available in the plant as well as SLDC/RLDC/NLDC as communication is the essential requirement and time is essence during the restoration process.
    - Loading of generator supplying the start-up power should not exceed 80% of its capacity. Efforts should be made to keep the generator operating on lagging side and if it is not possible then it should operate at least near to unity power factor.

Restoration of Transmission Lines

Transmission lines are the arteries of the electricity grid and these are most prone to damage due to earthquakes, cyclones, floods etc. Following points should be essentially considered for the restoration of transmission lines:

a) Intimation regarding the movement of identified personnel to disaster sites should be suffice and no sanction/approval from their standing hierarchy should be required.
b) In every utility, responsibility should be clearly defined for each section looking after O&M of transmission lines and they should have a contingency plan for various emergencies. The process of restoration /guidelines under different conditions should be laid down and documents should be made available to all disaster Management Committee/Task Force members.

c) The substation and other control centres should have details of the key front line personnel/task force members who are identified for handling restoration process in the event of a disaster so that deployment of these personnel to the affected areas can be made without delay.
d) Availability of the resources meant for tackling disaster/restoration process should be listed and the same should be available to the concerned members.
e) Each "Key front line personnel Team" shall be provided with a mobile/satellite telephone for ensuring instantaneous response/mobilization in occurrence of a disaster.
f) For the restoration of transmission lines, Emergency Restoration System (ERS) should be provided/made use of. The ERS, communication and other equipment should be maintained properly so that they can be used without any delay.
g) The transformer taps should be checked for the desired setting to minimize voltage difference.
h) Energising of high voltage lines and cables should be avoided until enough generating capacity is available.
i) Spare towers and conductors should be available with the agency having the responsibility of O&M of transmission lines. "CEA's guidelines for Availability of spares and inventories for power transmission system (Transmission lines & substation/switchyard) assets" shall be followed in this regard.
j) Strategic locations should be decided for spares on centralized/ regional /zonal basis.
k) In case of advance warning, the restoration team should reach at a convenient place nearest to the expected affected area in order to reach the spot at the earliest. The team would assess the extent of damage and inform higher coordinating authorities.
l) Alternate feed points should be identified for traction, defence location and other essential services.

Emergency Restoration Systems (ERS)

In case of damage to the transmission line, temporary arrangements for the restoration of power supply can be made with the help of ERS, which consists of a special type of lightweight modular structures, with lightweight polymer insulators and number of stays. It is, however, suggested that based upon the past experience of disaster-prone areas, one set of ERS for each such area should be procured and kept in store at strategic locations.

CEA has issued guidelines for requisition of ERS and advisory has been issued by Ministry of Power to all state utilities. As per Central Electricity Authority (grid standards) regulations, 2010, each transmission licensee shall have an

arrangement for the restoration of transmission lines of 400 kV and above and strategic 220 kV lines through the use of Emergency Restoration System in order to minimise the outage time of the transmission lines in case of tower failures.

Restoration of Sub-Stations

Substations are the nerve centres of the Electricity Grid. In case of any disaster, preparedness of the substation for restoration is a must. The following points need to be considered for handling various eventualities:

a) Every utility owning and operating the substations should carry out an in-depth analysis of all possible contingencies and should prepare plans for such contingencies.
b) Written standing instructions should be available at each substation to take care of various contingencies.
c) Alternate communications system should be available with every key substation.
d) The power backup facilities like D.G Set and inverter should be maintained properly and checked periodically for the readiness of operation in case of any emergency.
e) Each substation should follow the instruction given by concerned SLDC, RLDC and other coordination agencies.
f) The fire-fighting equipment and the bore wells / FFPH (Fire Fighting Pump House) should be maintained and checked periodically. Mock firefighting exercises should be done regularly.
g) The transportation arrangements in case of any emergency should be decided in advance.

Mobile Substations

Weather and natural disasters are the main cause of electrical outages, although most often these have a larger impact on power lines leading to and from the substations than on the substations and transformers themselves. Some natural disasters can harm substation operations and create a need for mobile substation systems. The most likely are intense storms and cyclones. If a powerful cyclone strikes a substation, the equipment might be destroyed and require replacement. Floods also can cause massive damage either from the force of the water or short-circuiting.

A Mobile Substation includes the trailer, switchgear, breakers, emergency or station power supply, a compact high-power-density transformer, and enhanced cooling capability. When needed, a Mobile Substation may enable temporary restoration of grid service. Mobile Substation deployment capability is a major advantage to utilities as it can be used to restore power supply in disaster affected

areas in 12-24 hours which otherwise may take several days to weeks. In addition to extend power supply during disaster, Mobile Substation may also be used during planned maintenance of sub-stations, in transmission as well as distribution sector, for temporarily increasing substation capacity, during forced outages, repairs and sabotage.

Restoration of Distribution Networks

a) Every distribution company must build up Emergency Operation Centre (EOC) with full logistics, conventional and alternative communication systems and connectivity with external authorities for assistance and support.
b) A team of identified positions from various functional departments should carry out network operations for early restoration of supply and for attending emergency calls such as cases of electrocution, fire accident, removing faulty equipment and rebuilding the system with available resources.
c) Consumer complaints such as no supply, report of electrocution, fire call, submerged supply installations etc. must be monitored and redressed on a priority basis.
d) The power supply of vital installations e.g. Drainage pumping stations, drinking water supply plants, hospitals, post offices, banks, government offices and residential complexes should be restored on a priority basis.
e) All temporary arrangements of supply should be restored to the normal mode of supply within a fixed time frame.

Role of Load Despatch Centers (LDCs) in Grid Restoration

NLDC/RLDCs/SLDCs play a vital role in coordination and controlling the restoration procedure for the Grids. In case of black out, the following points should be specially considered:

a) The responsibilities of each person should be clearly defined at the time of any emergency.
b) Backup power supply and voice/data communication facilities must be provided at these control centres and these should be regularly checked.
c) Minimum survival power/start-up power required for power stations and locations where black start facilities are available should be listed region wise and should be available with NLDC/RLDCs /SLDCs.
d) RLDCs/SLDCs should inform the power stations, which have black start facilities, to take immediate action.
e) For extending start-up power, from one constituent to another, clear authority should be given to SLDC indicating clearly the line through which such start-up power is to be extended, quantum of power and normal time

period. Concerned SLDC should be empowered to resort to load shedding or to bring up generation, wherever possible, to extend start-up power to neighbouring constituents during any crisis. SLDC shall take action in coordination with RLDCs.

f) Hydro Units / Gas Turbines should run, if possible, to provide start-up power and to control voltage.

g) Constituent-wise priorities of load which is to be connected in steps should be documented and while releasing loads, priority should be given to traction loads, underground coal mines /deep gassy mines AIR/TV/ Telephone exchange, hospital, pumping station, etc.

h) Some 132 KV lines in the system, which are normally kept off, may be required to be used during start-up procedure. Such lines should, therefore, be tested once in a month for healthiness.

i) Extension of power supply to mines particular for deep gassy mines shall be provided from the nearest sources of power available (may be even from islands that survived) in the shortest possible time in case of total grid collapse. This should be considered as essential service at the time of system restoration as it involves human lives.

j) NLDC shall coordinate with neighbouring regions after any partial or total grid collapse for extending the supply to the affected region. NLDC should also coordinate with RLDCs for smooth restoration. RLDC should play pro-active role with regard to determine the status of system, islands that survived and co-ordinate for extending start-up power from the survived islands. SLDC should also co-ordinate with Captive Power Plants for extending start-up power to the nearest power station.

k) Phase balancing should be kept in mind while extending power to the traction network during system restoration process.

l) The traction network should be available showing details of neutral section, feeding points mentioning utilities feeding the traction substation in NLDC/RLDC/SLDC. Details of traction load along with traction transformer capacity, average/ contracted demand and connected phase of the traction sub-station of concerned Railway(s) should be listed out clearly.

8.2.6 Media Management

During a disaster, media play a crucial role as a conduit of information in the affected region during response and recovery phase. Detailed information prior to disasters like floods, cyclones in coastal areas etc. can be gathered from early warning agencies such as IMD, CWC, etc. for accurate information at regular intervals. Early information about upcoming disasters helps in preparing for handling disaster effectively by taking precautionary measures like availability of manpower at strategic locations, availability of ERS towers in strategic locations,

availability of spare towers and hardware accessories, availability of sub-station spares like LAs, CVTs, Isolators etc.

Sharing information with print, radio and television media is an important aspect of Disaster Management. Designated spokespersons of Government should be accessible to media for providing information on disaster/emergency situations in power sector, for which a communication outreach strategy may be adopted in co-ordination with Ministry of Power. Further, Ministry of Power may designate spokesperson(s) and he should brief the media and issue press statements, if required in emergent situations.

Role of Social Media

In recent years, social media has emerged as a popular medium for providing new sources of information and rapid communications, particularly during natural disasters. It has become a vital tool aiding government and other rescue agencies to jump into action to exact locations, disseminate information to a wider audience, know the ground reality and so on. Social Media could be useful for Rescue, Rehabilitation and Relief during disaster management.

The use of social media for emergencies and disasters on an organizational level may be conceived of in two broad categories. First, social media can be used somewhat passively to disseminate information and receive user feedback via incoming messages, wall posts, and polls. A second approach involves the systematic use of social media as an emergency management tool for –

a) Conducting emergency communications and issuing warnings;
b) Receiving victim requests for assistance;
c) Monitoring user activities and postings to establish situational awareness; and
d) Using uploaded images to create damage estimates, among others.

The power utilities especially at the apex level such as power departments of states or the corporate offices of CPSUs must recognize the potential of social media and develop applications relevant to various aspects of disaster risk management.

Box-8.2: Common Response Measures:

- First Information/Perceive the threat/Assess the hazard.
- Deployment of human resources.
- Deployment of essential resources such as equipment, spare parts and other material.
- Control strategy – Do's & Don'ts, SOP for shutting down.
- Electricity Grid Restoration.
- Media Management

8.2.7 Disaster Resource Networks – National, State and District

India Disaster Resource Network (IDRN) is a portal providing nation-wide inventory of DM-related resources covering almost all basic needs. It is a web-based platform, for managing the inventory of equipment, skilled human resources and critical supplies for emergency response. Primary focus of IDRN portal is to enable the decision makers to find answers on availability of equipment and human resources required to combat any emergency. At the state-level, Government of India has encouraged each state to establish its own State Disaster Resource Network (SDRN) portal on the pattern of IDRN. The resource network shall cover national level, state-level and district level agencies involved in disaster risk management.

For the power sector specifically, an electronic inventory of disaster resources viz. Disaster Resource Inventory for Power Sector (DRIPS) has been developed and maintained by CEA in line with IDRN and hosted on National Power Portal (NPP) (a single web based portal for accessing all power sector related information) for ease of convenience of power utilities.

8.3 Disaster Specific Response Strategies

In addition to the general action plans discussed above, additional action plan needed during the occurrence of specific crisis/disaster situation has been explained in succeeding paragraphs.

8.3.1 Fire / Forest Fire

The following action plan is suggested to minimize the damage once a fire incident takes place in the power establishments:

a) The person who has the first information should pull/ operate the nearest fire alarm immediately.
b) The Safety department/Control room/higher officials should be informed.
c) The fire department number should be informed about the fire/emergency (of approximate) size and location; building, floor, room no. etc.
d) By the time Fire Brigade arrives, keep on trying to put off the fire and as Fire Brigade arrives, help them to put off the fire.
e) The person trained in handling fire extinguishers should use them immediately as per the procedure.
f) If fire fails to extinguish, then appropriate evacuation plan should be exercised.
g) If fire is extinguished, fire safety department should be informed to investigate the cause/extent of the situation.
h) The masses should be removed from the incident site.

i) The traffic in the incident area should be controlled and vehicles should be kept away from the incident site.
j) The road should be cleared for fire tender.
k) Lift should not be used during fire incidents.
l) All Air Conditioners & Ventilation systems should be switched off.
m) If fire incident takes place in main electrical equipment, then emergency shut down should be initiated as per SOP.
n) The incidental report and investigation analysis, shall be informed to higher authority.

8.3.2 Cyclone/Tsunamis

When cyclone/tsunamis alerts and warnings are on, the following action plan is suggested to minimize the damage:

a) Continuous vigil shall be kept on movement of cyclones/tsunamis.
b) Inventories at places near to likely cyclone/tsunami affected areas shall be checked and additional inventories shall be arranged, if required.
c) The ERS towers shall be moved to the nearest substation of likely affected area to save transportation time.
d) Expert manpower shall be deployed to the nearest station of likely affected area.
e) The heavy equipment provider/manufacturers/ contractors shall be contacted to get the information regarding availability of man and material required so that they can be immediately mobilised as per demand.
f) Adequate diesel shall be kept to run substation DG set continuously for 7 days at substations which are likely to be affected by the cyclone/tsunami.
g) The incidental report and investigation analysis, shall be informed to higher authority.

8.3.3 Floods/cloud burst/urban flood

When Floods/cloud bursts/urban flood alerts and warnings are on, the following action plan is suggested to minimize the damage:

a) Flood prone locations where substations, towers and buildings etc. are located shall be identified.
b) The likely affected areas shall be demarcated as per the severity of flood.
c) Adequate de-watering pump shall be arranged.
d) The trigger mechanism shall be established to initiate the action plan.
e) Arrangements shall be made to house the requisite manpower within the premises or nearby locations to ensure power supply.
f) The power supply should be switched off, if required, to avoid electrocution and other damages.

g) The incidental report and investigation analysis, shall be informed to higher authority.

8.3.4 Earthquake/Landslide/Snow Avalanche

The following action plan is suggested to minimize the damage in the event of an earthquake/Landslide/Snow Avalanche:

a) All employees should be informed to assemble at designated assembly points through PA system/ Alarm.
b) Employees should stay away from glass, windows, buildings, outside doors and walls, and anything that could fall such as lighting fixtures or furniture.
c) The power supply should be switched off to avoid electrocution due to falling electrical fixtures.
d) First aid desk shall be arranged near to the assembly point and emergency van shall be called to rush casualties, if any, to nearby hospital.
e) The incidental report and investigation analysis shall be informed to higher authorities.

8.3.5 Pandemic /Epidemic

a) The guidelines/protocols issued by the government to deal with emergency situations should strictly be followed.
b) The townships and power establishments may be declared as restricted entry zones. Exits may be permitted for family / non-essential staff to relocate (to their permanent addresses / other places).
c) Plans may be implemented to reduce the spread of the virus such as ensuing social distancing among workers, postponing non-essential activities and travelling, avoiding large business meetings in physical presence and implementing work-from-home policies.
d) The personnel may be deployed into two or three teams on notification of contagion risk. Teams so formed should be self-sufficient for operation and should isolate themselves from other teams.
e) The plan should be put in place to run the system with minimum number of employees.
f) The availability of key personnel such as power plant operators, line workers, and call center representatives should be ensured. Depending on the severity of a pandemic, the services of contractors and other companies may be utilized.
g) The non-critical activities may be suspended or postponed.
h) The proper vigilance mechanism may also be placed for protecting the power infrastructure from malicious actors seeking to capitalize on adverse situations.

An indicative list of Do's & Don'ts in case of fire, cyclone/tsunami & earthquake is available at **Annexure-II**.

8.4 Institutional Framework

The immediate response in the event of a disaster lies with the local authorities with the support of the state government, central government and specialized agencies. The central government supplements the efforts of state government by providing logistic and financial support, deploying NDRF, Armed Forces, CAPF, and other specialized agencies mandated to respond to particular types of disasters. It will depute experts to assist the state government in planning and its implementation as per request from the state government.

The institutional arrangements for the response system at the center and state levels are:

a) Nodal central ministries with disaster-specific responsibilities for national-level coordination of the response and mobilization of all the necessary resources.
b) Central agencies with disaster-specific responsibilities for Early Warning Systems and alerts.
c) National Disaster Response Force (NDRF).
d) State Disaster Response Force (SDRF).

Also, a four-tier controlling system as listed below at various level are to be set up for effective coordination of the various events and happenings during the time of disturbance and collecting & compiling all information for timely communication to the concerned people.

a) National Load Despatch Centre (NLDC) as Central Control room with headquarters at New Delhi.
b) Regional/ Load Despatch Centre (RLDCs) as Regional control room.
c) State Load Despatch Centres (SLDCs) as State level control room.
d) Field level (Power Plant / Grid sub-station level) control room.

The control room at the field level would be the nodal point to communicate with the State Control Room, Regional Control Room and other outside agencies. Ministry of Power, Government of India has designated NLDC as Central Control room to deal with /disasters in the power sector. To facilitate dissemination of information by the Nodal Officer of Central Control Room, effective coordination of NLDC with the nodal officer(s) of RLDCs and in turn SLDCs is of vital importance. In addition, the interface of Central control room with nodal officers of Central Public Sector Undertakings (CPSUs) as well as State level control rooms is also required.

An overview of the institutional arrangements covering all aspects of disaster management is given in the Chapter "Institutional Framework for Disaster Management" (Chapter No. 2).

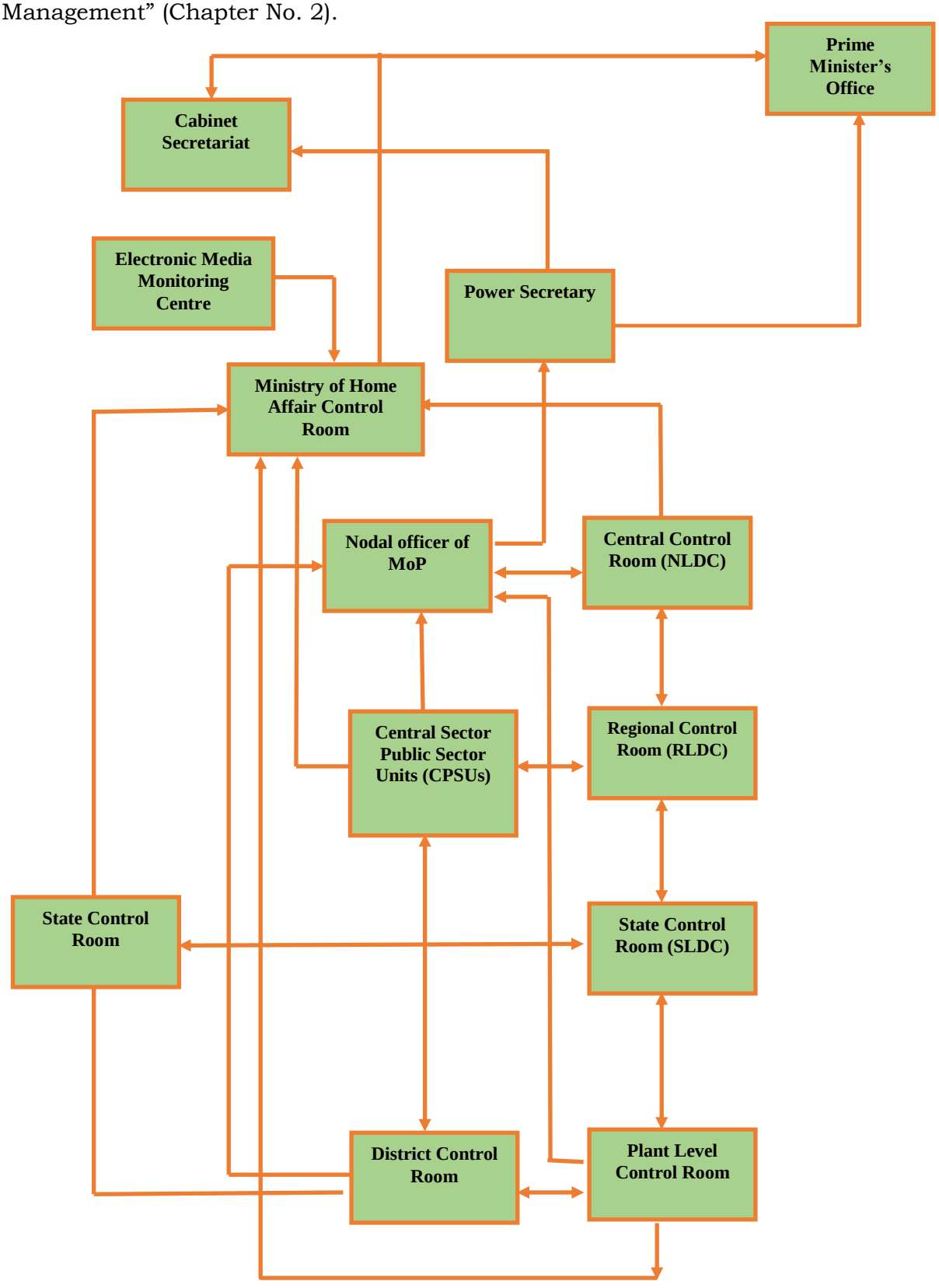

Figure-8.1: Flow Chart for Information

8.4.1 National Early Warning System

The GoI has designated specific agencies (Table-8.1) to monitor the onset of different natural disasters, set up adequate Early Warning Systems (EWS), and disseminate necessary warnings/ alerts regarding any impending hazard, for all those hazards where early warning and monitoring is possible with currently available technologies and methods. These agencies provide inputs to MHA, which will issue alerts and warnings through various communication channels.

Table-8.1: Central Agencies Designated for Natural Hazard-Specific Early Warnings

Sl. No.	Hazard	Ministry	Agency
1.	Avalanches	MoD	Snow and Avalanche Study Establishment (SASE)
2.	Cold Wave	MoES	India Meteorological Department (IMD)
3.	Cyclone	MoES	India Meteorological Department (IMD) Regional Specialized Meteorological Centre (RSMC) and Tropical Cyclone Warning Centres (TCWC) for different regions
4.	Drought	MoAFW	Central Drought Relief Commissioner (CDRC) and Crop Weather Watch Group (CWWG)
5.	Earthquake	MoES	India Meteorological Department (IMD)
6.	Epidemics	MoHFW	Ministry of Health and Family Welfare (MoHFW)
7.	Floods	MoJS	Central Water Commission (CWC)
8.	Heat Wave	MoES	India Meteorological Department (IMD)
9.	Landslides	MoM	Geological Survey of India (GSI)
10.	Tsunami	MoES	India National Centre for Oceanic Information Services (INCOIS)

On their part, the relevant State Government and district administration disseminate such alerts and warnings on the ground through all possible methods of communication and public announcements.

8.4.2 Emergency Functions and Responsibilities: Centre and State

While there are disaster-specific aspects to post-disaster response, emergency functions are broadly common to all disasters and there are specific ministries, departments, or agencies that can provide that emergency response. Besides, very often, there are multiple hazards and secondary disasters that follow a major disaster. Hence, response intrinsically follows a multi-hazard approach. Therefore, all the response activities have been summarized in a single matrix applicable to all types of disasters. The response responsibility matrix specifies the major theme of

response. It specifies the agencies from the Central and State Governments responsible for the major theme of response. Certain agencies of Central Government play a lead role, while others are in a supporting role. The SDMA, COR, or the Dept. of Revenue is the nodal agency at the state level for coordination of response.

Table-8.2: Responsibility Matrix for Preparedness and Response

Preparedness and Response					
Sl. No.	Emergency Function	Central/ State Ministries/ Departments and their Responsibilities			
		Centre	Responsibility – Centre	State	Responsibility – State
1	Communication	**Lead Agencies:** MCOM, DoT **Support Agencies:** MoR, MoCIT, MoD, Telecom Providers	➢ Detailed plans for fail safe communication with all the early warning agencies (such as IMD, CWC, etc.) and Control Rooms (Central/ State) for getting accurate information at regular intervals ➢ Restoration of emergency communication in disaster affected areas ➢ Emergency response teams to be in place with detailed technical plans to restore communication after the occurrence of a disaster ➢ Provide a dedicated radio frequency for disaster communications ➢ Mobile communication units fitted with V- SAT terminals, VHF repeaters, reserve WT VHF Sets, portable mobile towers, etc. ➢ Contingency plans including pre-disaster contracts with suppliers – government and private– for easy availability of resources at the time of emergency	**Lead Agencies:** IPRD **Support Agencies:** State/UT, SDMA, RD, DMD, SEOC, DDMA, all other relevant departments	➢ Failsafe communication plan is prepared with all early warning agencies ➢ Logistic section of the state level IRT coordinates with central agencies to provide effective communication support to the field level IRTs for response. ➢ State and district EOCs are equipped with satellite phones/ VHF/ HF as a backup to the landline ➢ All communication equipment, especially the satellite phones are in good working condition 24x7 on all days through regular testing ➢ Plans for communication including telephone and HAM is prepared for smooth coordination with the field level IRTs ➢ Establish protocols and responsibilities for coordinating with central agencies and various service providers ➢ Prepare, update and maintain a District wise list of HAM

Preparedness and Response					
Sl. No.	Emergency Function	Central/ State Ministries/ Departments and their Responsibilities			
		Centre	Responsibility – Centre	State	Responsibility – State
			➢ Operational plan for establishing temporary telecommunication facilities in the affected areas jointly with the State Government ➢ Secure, failsafe communication network among Central, State and other Control Rooms for exchanging reliable and authentic information about the affected areas, and resource mobilization ➢ Prepare, update and maintain a State wise list of HAM Operators who could be contacted and deployed at the site of emergency when all other modes of communication fail ➢ Inter-Operability (the ability of emergency responders to communicate among jurisdictions, disciplines, and levels of government using a variety of frequency bands, as needed and as authorized) of mobile service providers		Operators who could be contacted and deployed at the site of emergency ➢ Have binding agreements with telecom service providers to restore damaged facilities and set up temporary facilities on emergency basis ➢ Ensure Inter-Operability among different telecom service providers
2.	Data Collection and Management	**Lead Agencies:** MHA, NDMA **Support Agencies:**	➢ Maintain proper records of all the essential services needed for rescue, response and relief phases, both by the State Governments and by the	**Lead Agencies:** DMD **Support Agencies:**	➢ Representative of SDMA works with the planning section at state level for making of IAP and dissemination of information.

Preparedness and Response					
Sl. No.	Emergency Function	Central/ State Ministries/ Departments and their Responsibilities			
		Centre	Responsibility – Centre	State	Responsibility – State
		NIDM, MoIB, MCOM, MoST, MoES, MoJS, MoEFCC, ministries/ departments with hazard - specific responsibilities	Central Ministries/ Departments ➢ Establish a sound reporting mechanism to meet the information needs of both Central and State Governments about the disaster response	State/UT, RD/ SEOC, SDMA, DDMA, Bureau of Economics and Statistics, all other relevant Departments	➢ Creation of a cell at the District level (preferably as part of DEOC) and place dedicated resources to collect/ update data on all essential services (as per the template given in the IRS guidelines) which will help during the response phase for effective reporting and compilation.
3.	Early Warning, Maps, Satellite Data, Information Dissemination	**Lead Agencies:** See Table-8.1 **Support Agencies:** Ministries and agencies as described in the relevant NDMA guideline	➢ Issue forecasts, alerts, warnings ➢ Provide early warnings (where possible) to reduce loss of life and property. ➢ Disseminating warnings and information to all Central Ministries/ Departments/ Agencies and State Government ➢ Use of satellite imageries and other scientific methods for risk assessment and forecasting	**Lead Agencies:** DMD **Support Agencies:** State/UT, SDMA, RD., COR, SEOC, DDMA, all other relevant Departments / Agencies	➢ To disseminate early warning signals to the district administration, local authorities, and the public at large in the areas likely to be affected by a disaster so as to reduce loss of life and property ➢ Dissemination of warnings and information up to the last mile ➢ Ensure appropriate compilation/ analysis of received data ➢ Use of satellite imageries and other scientific methods for risk assessment and forecasting
4.	Media Relations	**Lead Agencies:** MoIB, MHA,	➢ Collect, process and disseminate information about an actual or potential disaster	State/UT, SDMA, RD, COR, SEOC,	➢ Dept. of Information and Public Relations works with the Command staff as Information

Preparedness and Response					
Sl. No.	Emergency Function	Central/ State Ministries/ Departments and their Responsibilities			
		Centre	Responsibility – Centre	State	Responsibility – State
		NDMA **Support Agencies:** MCOM, MoST, MoES, MoJS, MoEFCC, ministries/ departments with hazard-specific responsibilities	situation to all stakeholders so as to facilitate response and relief operations; update information on disaster and disaster victims; maintain contacts with mass media; inform public regarding the impact of disaster and the measures taken for the welfare of the affected people ➢ Ethical guidelines for disaster coverage by media as per accepted global standards respecting dignity and privacy of the affected communities and individuals and work with media to adopt the guidelines through self- regulation as well as oversight by relevant regulatory institutions ➢ Mechanisms for broadcasting warnings, do's and don'ts etc. to media and public before (if applicable), during and after the disasters ➢ Proper schedule for media briefing (once/ twice/ thrice daily depending on the severity of the disaster) and designate a nodal officer	**Lead Agency:** IPRD **Support Agencies:** State/UT, SDMA, RD,DMD, SEOC,DDMA	and media officer of the state level IRT to provide effective services ➢ Ethical guidelines for coverage of disaster is prepared and shared with all media agencies ➢ Plan is prepared for providing/ ➢ broadcasting warnings, do's and don'ts etc. to media and ensure its dissemination

Preparedness and Response					
Sl. No.	Emergency Function	Central/ State Ministries/ Departments and their Responsibilities			
		Centre	Responsibility – Centre	State	Responsibility – State
5.	***Power***	***Lead Agencies: MoP*** ***Support Agencies: MoNRE, MoPNG, Power generating/ distribution companies***	➢ ***Assistance to the respective state government in repairing power infrastructure; restore power supply in the disaster-affected areas; help power companies in establishing emergency power supply*** ➢ ***Arrangements of alternate sources of power such as generator sets, solar lanterns, portable tower lights, etc. until resumption of normal power supply*** ➢ ***MoU is in place with suppliers for required supplies usually within 24 hours of placement of order*** ➢ ***Technical support to the State Government for restoration of power supply as well as infrastructure on request***	***Lead Agency: SEB, DISCOM Support Agencies: State/UT, SDMA, RD, DMD, SEOC, DDMA,***	➢ ***Electricity Board and Power Distribution Companies work with the logistic section of the state level IRT to provide effective services to the field level IRTs for response*** ➢ ***Pre-disaster arrangements for quick restoration of power supply with alternate mechanisms to critical facilities usually within 6 to 12 hours of placement of order*** ➢ ***Pre-disaster agreements with central and neighbouring state governments for technical support in restoration of power supply and infrastructure*** ➢ ***Mobile power supply units or other arrangements with power generation companies for quick deployment at the site during emergency***

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9. Recovery and Reconstruction

UNDRR defines recovery as

> *"The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk."*

Recovery task begins soon after the emergency phase ends, and it should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action. The focus of recovery is on restoring livelihoods and on shifting to a path of sustainable development that reduces disaster risk. The plan for recovery should be designed keeping in view the worst-case scenarios.

Recovery stage covers immediate restoration to long-term betterment reconstruction. It tends to be difficult and long-drawn out process. Reconstruction will vary depending on the actual disaster, location, pre-disaster conditions, and the potentialities that emerge at that point of time.

9.1 Steps of Recovery Process

The entire recovery process is rarely a set of orderly actions and it consists of several related activities. The major steps/ processes of the recovery process and the key sub-processes involved are summarized in Table-9.1.

Table-9.1: Major steps of the recovery process and the key sub-processes involved

Sl. No.	Major Steps/ Processes	Sub Processes Involved
1.	Post-Disaster Needs Assessment and Credible Damage Assessment	➢ Preliminary assessment reports ➢ Compilation and transmittal of damage and loss data ➢ Disaster damage assessments led by government and assisted by humanitarian response agencies, and the initial damage surveys leading to a comprehensive assessment ➢ Quantitative and qualitative baseline for damage, loss, and needs across sectors, blocks (taluka) and districts ➢ Results monitoring and evaluation plan for recovery program ➢ Select the most appropriate and achievable processes and methodology for conducting early and credible damage and needs assessments

Sl. No.	Major Steps/ Processes	Sub Processes Involved
2.	Developing a vision for Build-Back Better (BBB)	➢ High level meetings as well as broad-based, wider consultations with experts, civil society, and key stake holders ➢ Build consensus among the range of stakeholders within and outside government
3.	Ensure coherence of BBB with the development programs and goals	➢ Discussions at top level to align the recovery vision with the government's broader, longer term development goals and growth and poverty reduction strategies
4.	Incorporating resilience and BBB in recovery vision	Consultations and background studies on: ➢ Disaster resistant physical recovery ➢ Options for fast economic recovery ➢ Gender and equity concerns ➢ Vulnerability reduction ➢ Natural resource conservation and environmental protection ➢ Social Recovery
5.	Balancing recovery across sectors	➢ Balance public and private sectors BBB programs ➢ Promote norms for non-discriminatory and equitable asset disbursement among individuals and communities ➢ Prioritize infrastructure reconstruction ➢ Address recovery of the lives and livelihoods of disaster affected communities ➢ Show sensitivity to the needs of the affected population with regard to public expectations from recovery.
6.	Prioritising sectors for recovery	➢ Determine relative importance of various sectors such as housing, water and sanitation, governance, transport, **power**, communications infrastructure, environment, livelihoods, tourism, social protection, health and education

Immediately following a disaster, an initial damage assessment must be performed by the plant level emergency management group (EMG) to assess the impact of the disaster on the electrical infrastructure. The assessment should provide a rough estimate of the type and the extent of damages, including probable cost and need for financial assistance. When information has been collected, it should be transmitted to the appropriate authority in the state government. Once state government has received the preliminary incident damage assessment information, it carries out a damage assessment. When the state and local resources are inadequate to effectively respond to an emergency or disaster, central assistance shall be sought by the State.

It is very important that analysis and identification of lessons learnt are carried out and everything has been restored to normal after a disaster has occurred. The purpose is to take stock of what worked and what did not work, and identify gaps in the current system and find out specific ways of improving disaster preparedness. This shall be followed by updation of Disaster preparedness plans.

Globally, the approach towards post-disaster restoration and rehabilitation has shifted to one of betterment reconstruction. While disasters result in considerable disruption of normal life, enormous suffering, loss of lives and property, global efforts consider the recovery, rehabilitation and reconstruction phase as an opportunity to "Build Back Better" (BBB) integrating disaster risk reduction into development measures and making communities resilient to disasters. Para 9.1.1 of the NPDM also acknowledges this and states that "*the approach to the reconstruction process has to be comprehensive so as to convert adversity into opportunity. Incorporating disaster resilient features to 'build back better' will be the guiding principle*". Building back better envisages seizing the opportunity to rebuild to reduce development deficits of the affected areas going beyond restoration to the pre-disaster 'normal'.

It is the best practice to encourage resilient recovery with optimal incentives. The optimal combination of regulation and incentives (both financial and non-financial) can stimulate a resilient recovery. Effective government incentives can be localized depending on the particular characteristics of each region's infrastructure and private sector capacity. Leading practices for rebuilding resilient infrastructure are as follows:

a) Formulate long-term vision, guided by community and regional growth strategies.
b) Prioritize projects based on strategic importance, potential value, and available resources.
c) Assess land-use impacts and construction regulations.
d) Incorporate economic, sustainability, and livability goals.
e) Evaluate financing alternatives; capitalize on private-sector financing and experience.
f) Provide transparency and close control over funds and capital projects.
g) Establish centralized capital project management and risk oversight.

The plans for reconstruction in highly disaster prone areas need to be drawn out during the period of normalcy. Central Ministries / Departments concerned, the State Governments and the power utility should create dedicated project teams to speed up the reconstruction process.

Box-9.1: Major Steps/processes involved in recovery process:

- Post-Disaster Needs Assessment and Credible Damage Assessment
- Developing a vision for Build-Back Better (BBB)
- Ensure coherence of BBB with the development programs and goals
- Incorporating resilience and BBB in recovery vision
- Balancing recovery across sectors
- Prioritising sectors for recovery

9.2 Early, Mid and Long-term Recovery

There are three recovery phases after a disaster: a) Early – three to eighteen months, b) Medium – within five years and c) Long-term – between five to ten years for planning appropriate policies/programmes and their implementation. As emphasised, the recovery phase can be considered as an opportunity to build back better, integrating disaster risk reduction into development measures and making communities resilient to disasters.

Table-9.2: Recovery Stages

Recovery Stage	Duration	Brief Description
Early	3 – 18 Months	Make permanent restoration of the plant & equipment lines which were temporarily restored.
Mid-Term	Up to 5 Years (concurrent with early recovery)	Reconstruction plans for Power infrastructure.
Long-Term	Within 10 Years	Implemented along with developmental plans - infrastructure strengthening

9.3 Fund Mobilization

Reconstruction and rehabilitation projects after a major disaster are usually highly resource intensive. Such projects are typically financed through the state exchequer. Recently, large funds have been raised from multilateral/ bilateral funding agencies/ international agencies in close coordination with the national Governments. The State Government, through the relevant ministry of the Central Government, shall finalize fund mobilization strategy, incorporating appropriate conditions governing flow of funds, its disbursement, and usage as per norms decided by the Central Government. This will include:

i. Estimation of funds required based on the detailed damage assessment reports and consolidation of the same under sectoral and regional heads.

ii. Contracting with funding agencies and evolving detailed operating procedures for fund flow and corresponding covenants.

The funds may be arranged from internal as well as external sources. The domestic or internal sources of on-budget government funds usually consist of the following:

a. Government operational and capital budgets
b. Reallocation among the budget items to disaster-hit sectors
c. Special levies or taxes; additional taxes or surcharge for recovery
d. Contingency financing arrangements
e. Issuing sovereign reconstruction or development bonds
f. Introducing policy incentives for the private sector to share recovery costs
g. Voluntary contributions from civil society and private philanthropies
h. Insurance/ risk transfer mechanisms etc.

The fund for post-disaster reconstruction can also be sourced from external resources such as multilateral development banks, regional development banks, bilateral development partners, international NGOs, private philanthropies and charities, and remittances. For recovery of the reconstruction costs, the State Government, in consultation with the relevant Ministry of the Central Government, can finalize and implement select cost recovery measures such as imposing special tax/ surcharge (Central Government), imposing local taxes, issuing tax free Government bonds etc.

Box-9.2: Leading practices for rebuilding resilient infrastructure:

- Formulate long-term vision, guided by community and regional growth strategies.
- Prioritize projects based on strategic importance, potential value, and available resources.
- Assess land-use impacts and construction regulations.
- Incorporate economic, sustainability, and liveability goals.
- Evaluate financing alternatives; capitalize on private-sector financing and experience.
- Provide transparency and close control over funds and capital projects.
- Establish centralized capital project management and risk oversight.

Box-9.3: Recovery phases after a disaster:

- Early (3-18 months) - Permanent restoration of the plant & equipment lines which were temporarily restored.
- Medium (within 5 years) - Reconstruction plans for Power infrastructure.
- Long-term (5-10 years) – Implementation along with developmental plans (Infrastructure strengthening).

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Chapter-10

10. Capacity Building

UNDRR defines "Capacity Development" for DRR as:

> *"Capacity development is the process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals. It is a concept that extends the term of capacity-building to encompass all aspects of creating and sustaining capacity growth over time. It involves learning and various types of training, but also continuous efforts to develop institutions, political awareness, financial resources, technology systems and the wider enabling environment."*

Investing in capacity development for DRR is a continuing process of enhancing the capability of individuals, agencies, and communities to improve performance of their DM functions. It is a cost-effective way to save lives, prevent or reduce losses and ensure effective recovery and rehabilitation.

The process of capacity building will include elements of human resource development, i.e., individual training, organizational development such as improving functioning of groups, and strengthening of organizations, regulations, and institutions. It also includes curriculum development, large-scale awareness and carrying out regular mock drills and disaster response exercises.

The National Policy on Disaster Management provides for development of Disaster Management handling capability by each Ministry/Department of the Central Government as also by the State Government. The policy also lays down that all Central Ministries and Departments will prepare their DM Plans and where funds are being asked for to improve Disaster Management capability including the financial projections to support these plans. The necessary budgetary allocations will be made as part of the five Year and Annual Plans.

NPDM 2009 envisages a pivotal role for the National Institute of Disaster Management in capacity development. Similarly, State Disaster Management Institutes and Administrative Training Institutes (ATI) should play a lead role in the States/ UTs. NPDM envisages capacity development in the domain of DM at all levels of government including ministries, line departments and across various autonomous institutions. It also stresses the importance of capacity development efforts to promote community-based DM efforts. The policy notes that to sustain DRR, it is necessary to undertake capacity development across the education sector covering schools to professional institutions. It recognizes skill development in all sectors to incorporate multi-hazard resistant features along with strengthening of relevant licensing, certification, and standards.

10.1 National Institute of Disaster Management and other Institutions

The NIDM, in partnership with other research institutions, has capacity development as one of its major responsibilities, along with training, research, documentation and development of a National level information base. It will network with other knowledge-based institutions and function within the broad policies and guidelines laid down by the NDMA. It will organise training of trainers, DM officials and other stakeholders. NIDM will play an important role in developing and facilitating implementation of a National training schedule for DM. It will also be the nodal institution for Regional and International cooperation for training. There are several renowned institutes in various States, which are imparting training in DM. These will be strengthened with skilled resource persons and financial assistance and such efforts will be replicated by other States/UTs. Also, DM cells in all ATIs, Police Academies, State Institutes of Rural Development, Training centres of five CAPFs from where NDRF is drawn up (BSF, CRPF, CISF, ITBP, and SSB) and the National Training Academy will contribute most significantly in developing DM related skills. The capacity of existing institutes needs to be upgraded in accordance with regional and local requirements.

10.2 Capacity Building Areas of Power Sector

The disaster specific capacity building responsibilities for centre and state for disaster risk reduction and building resilience are described in greater detail in the responsibility framework given in Chapter 7. For the power sector specifically, all power sector utilities should carry out capacity building in the following areas.

Table-10.1: Capacity Building Areas of Power Sector

Sl. No.	Key Aspects	Thematic Areas
1.	Prevention or mitigation for disaster risk reduction	➢ Building Resilience in Electricity Infrastructure. ➢ Risk assessment and Vulnerability study in each area of responsibility. ➢ Public Awareness Programmes. ➢ Mainstreaming of disaster risk assessment, mapping and management into development plans and programs
2.	Effective preparedness and response	➢ Response and recovery ➢ Responsibilities of Teams ➢ Black Start Facilities ➢ Emergency Restoration Systems (ERS) ➢ Mock Drill Exercises ➢ Adoption and adaptation of emerging global good practices ➢ Early warnings, maps/ satellite data/ effective dissemination of information

Sl. No.	Key Aspects	Thematic Areas
		➢ Rescue equipment at all levels ➢ Systems to provide basic services in emergencies ➢ Medical care for casualties, health care and sanitation ➢ Media relations
3.	Recovery and Build Back Better	➢ Post-event investigation & analysis and strategy for the future ➢ Damage assessment mechanisms. ➢ Planning capabilities to ensuring coherence of BBB with overall development efforts and goals ➢ Studies on past disasters and recovery to draw useful lessons

As a common practice for capacity building, general information on Do's and Don'ts in respect of power sector including precautions to be taken during emergency situations should be put in the public domain for reference and guidance of the general public. As inputs/experience of utilities/ stakeholders would be helpful to sensitize the organizations regarding the need for effective disaster management, utilities/ stakeholders should share their experiences among themselves.

10.2.1 Mock Drill Exercises

In order to be prepared for any eventuality, periodic mock drill exercises are to be undertaken in various areas of generation, transmission and distribution of the power sector by considering various disaster situations like an earthquake, floods etc. Depending on the vulnerability of the installations/plant, mock drills to handle such situations need to be undertaken. The utilities are also required to ensure that at least one mock drill exercise for every disaster situation to which the installation/plant is vulnerable is undertaken in each quarter. The adverse observations made on each event of Mock drill should be taken into account and it should be ensured to prevent occurrence of such undesirable events in the future.

A quarterly report on the mock drill exercises undertaken indicating the outline of disaster situation, response of the various teams, observations and effectiveness for handling the emergency situation and scope for improvements etc. are to be sent by each utility to CEA for onward submission to Ministry of Power.

10.2.2 Public Awareness Programs

Organizing public awareness programmes is very important when prior information is available about a situation that may lead to a disaster in the near future. The people living around the project can play a vital role in the event of a disaster. For this purpose, public awareness programme should be conducted regularly to make the general public aware of potential hazards likely to occur in the project area.

Emphasis may be given to the following aspects.

a) Pamphlets and booklets containing details Do's & Don'ts in the event of emergency situations and hazards associated with power utilities should be prepared and made available to the general public.
b) Local TV Channels, Print Media and Social Media may also be used from time to time for this purpose.
c) Permanent notice boards should be fixed at all suitable places in the area displaying information maps, escape routes, precautions to be taken and emergency communication details of nodal officers.
d) Help from local youth organizations, voluntary organizations, educational institutions be sought to conduct an educational session to make people aware of the safety measures and rescue operations in the event of a disaster.

Box-10.1: Capacity Development:

- National Institute of Disaster Management (NIDM) has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation, and policy advocacy in the field of disaster management.
- The disaster specific capacity building responsibilities are assigned to disaster specific nodal ministries and organizations as defined in NDMP.
- The responsisibilty of capacity development in power sector are entrusted to MoP, CEA, CPSUs, NLDC, RLDCs, NPTI, CPRI at national level and state power department and state power utilities at state level (Refer Table 7.12).

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Chapter-11

11. Financial Arrangements

The financial aspects of Disaster Risk Management entail various factors ranging from development planning to immediate relief post disaster, followed by investments made for reconstruction and for this purpose, appropriate financial allocations are imperative.

Section 49 of Disaster Management Act, 2005 provides for allocation of funds by Ministries and Departments. It states that:

> *"(1) Every Ministry or Department of the Government of India shall make provisions, in its annual budget, for funds for the purposes of carrying out the activities and programmes set out in its disaster management plan.*
>
> *(2) The provisions of sub-section (1) shall, mutatis mutandis, apply to departments of the Government of the State."*

As evident from the above, DM Act 2005 has clearly mandated upon the Government to ensure that the funds are provided by the Ministries and Departments within their budgetary allocations for the purpose of disaster management. The Act has stressed upon the need for mainstreaming of Disaster Risk Management by way of making definite budgetary arrangements for the purpose by the respective Ministries and Departments within their overall agenda. Under the Act, a financial mechanism has also been set up by way of National Disaster Response Fund (NDRF) at the national level and State Disaster Response Fund (SDRF) at the state level to meet the rescue and relief expenditure during any notified disaster.

11.1 National Disaster Response Fund (NDRF)

The state government is primarily responsible for undertaking rescue, relief and rehabilitation measures in the event of a natural disaster. In the event of a calamity of a severe nature, where the requirement of funds for relief operations is beyond the funds available in the State's SDRF account, additional Central assistance is provided from NDRF after following the laid down procedure. As per this procedure, the State Government is required to submit a memorandum indicating the sector wise damage and requirement of funds. On receipt of the memorandum from the State, an inter-Ministerial Central Team is constituted and deputed for an on the spot assessment of damage and requirement of funds for relief operations, as per the extant items and norms of SDRF and NDRF. After examination, a High Level Committee approves only the quantum of immediate relief to be released from NDRF as providing financial assistance for disaster preparedness, restoration,

reconstruction and mitigation in the event of a natural disaster are not part of NDRF's mandate.

11.2 State Disaster Response Fund (SDRF)

SDRF is a resource available to the States to meet expenses of relief operations of immediate nature, for a range of specified disasters. The funds in SDRF are contributed by the Central Government and State Governments in the ratio of 75:25 for general category states and 90:10 for North Eastern and Himalayan States. The aggregate size of the SDRF for each state, for each year, is decided as per the recommendations of the Finance Commission. The financing of relief measures out of SDRF is decided by the State Executive Committee (SEC) constituted under Section 20 of the DM Act. At any point, a fair amount of funds should be available under the SDRF.

11.3 National Disaster Risk Management Fund (NDRMF)/ State Disaster Risk Management Fund (SDRMF)

The report of the 15th Finance Commission that has also been accepted by the government of India, has recommended for creation of National Disaster Risk Management Fund (NDRMF)/ State Disaster Risk Management Fund (SDRMF) to include disaster mitigation aspects also and recommended for 80:20 ratios of fund allocation for Response (National Disaster Management Fund - NDRF/State Disaster Management Fund - SDRF) and Mitigation (National Disaster Management Fund – NDMF / State Disaster Management Fund – SDMF) activities respectively from NDRMF/SDRMF. Within NDRF/SRRF allocation also, three sub-allocations have been recommended as - Response and Relief (40%), Recovery and Reconstruction (30%); and Preparedness and Capacity-building (10%).

11.4 Implementation of DRR – Financial Aspects

The financial aspects of DRR components need to be embedded with the financial planning of any developmental scheme as explained in Chapter 5 i.e. "Mainstreaming Disaster Risk Reduction". The financial outlay for reconstruction activities at the wake of any disaster is also normally embedded in the plan schemes of the Union Government to ensure that "Building Back Better" is in consonance with the approved programs. Post disaster reconstruction work is funded by the Union Government through increased outlay for the ongoing infrastructure projects in the region and providing more untied grants to the affected State. The Centre/State may also utilize funds from international agencies for specific intervention in a particular region in the form of an externally aided project.

11.5 Financial arrangement specifically for Power Sector

Each power utility shall create a fund for meeting the requirement of disaster management plan. The disaster management fund would be 1.5% of the annual revenue of the utility. Besides the above, every utility should have a core corpus of sufficient amount especially for immediate relief and rehabilitation depending upon revenue potential of the utility and the same should be replenished on an annual basis.

As during the disturbance period, the various heads of the departments need more financial power to meet the various contingencies, enhancement of financial powers/ impress money shall be available for the disturbance period. Arrangements for adequate financial resources must be made so that the restoration activities do not get hampered because of a shortage of funds. The authorized signatory may be designated for each strategic location that can make decisions in this regard.

Power utilities may also seek financial assistance from specialised funding agencies to meet any funding requirement. They may enter into a financing arrangement in advance as it will reduce the response time in organising the funds at the time of disaster. The Power Utility/State Government may also enter into an arrangement with financial institutions for funding certain activities under the Disaster Management Plan (like project financing, building disaster resilient infrastructure, strengthening of existing infrastructure etc). This arrangement will help utility to develop infrastructure which is less prone to damage due to occurrence of natural calamities.

Insofar relief under NDRF/SDRF is concerned, assistance is provided for the repair of damaged power sector infrastructure of immediate nature only. It is given for damaged conductors, poles and transformers up to the level of 11 kV as per the norms of assistance issued by SDRF and NDRF from time to time.

11.6 Risk Transfer and Insurance

Risk transfer is a risk management and control strategy that involves the contractual shifting of risk from one party to another such as insurance. The power utilities should ensure adequate insurance measures for critical and valuable equipment and establishment. Appropriate insurance coverage should also be ensured for the employee for disaster-related mishaps.

Box-11.1: Financial Arrangement:

- Under the DM Act, 2005, a financial mechanism has also been set up by way of NDRF at the national level and SDRF at the state level.
- Each power utility shall create a fund of 1.5% of the annual revenue for disaster.
- The power utilities should ensure adequate insurance measures for critical and valuable equipment/establishment and its employee for disaster-related mishaps.
- The power utilities may enter into a financing arrangement from funding agencies in advance.

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12. Plan Management

As per section 37 of the Disaster Management act 2005, each Ministry or Department of Government of India is required to prepare a Disaster Management Plan. Accordingly, Ministry of power, in association with CEA, prepares Disaster Management Plan (DMP) for the power sector in consultation with all stakeholders. CEA is responsible for developing, maintaining, reviewing and updating the basic disaster management plan for power sector at the national level. The document is reviewed annually. With a view to periodically review this booklet, the inputs, updated information would be obtained from stakeholders. For this purpose, a Permanent Standing Committee under Chairmanship of Member (Planning), CEA, with representatives of CPSUs, State utilities/IPPs and other concerned organizations would be constituted.

All the power utilities (Central/State/Private) associated with construction and operation of generation, transmission, distribution facilities and load despatch centres are required to prepare their own disaster management plan and are to accord the highest priority to building up their own Disaster Management Capabilities at all levels in consonance with the Guidelines and provisions of Disaster Management Act, 2005. The Disaster Management Plan of each utility should be updated annually by the concerned utility in the month of December and the revised plan should be furnished to MoP/CEA. A brief description of disasters happened in the past and the lessons learnt should be included in the plan document. The updated plan should take into account the experiences gained from past disasters, which occurred during the period under review. It should also be reviewed and updated as indicated below:

- Major review and revisions after each major incident
- After significant change in operational resources (e.g., policy, personnel, organizational structures, management processes, facilities, equipment)
- Subsequent to any notification or formal update of planning guidance or standards
- After every case of plan activation in anticipation of an emergency
- After the completion of major exercises
- A change in the district's demographics or hazard or threat profile
- Enactment of new or amended laws or ordinances

Box-12.1: Plan Management:

- CEA is responsible for developing, maintaining, reviewing and updating the Disaster Management Plan for Power sector at the National level.
- The document is reviewed annually.
- A Permanent Standing Committee under Chairmanship of Member (Planning), CEA, with representatives of CPSUs, State utilities/IPPs and other concerned organizations would be constituted for reviewing the document.
- All the power utilities (Central/State/Private) associated with construction and operation of generation, transmission, distribution facilities and load despatch centres are required to prepare their own disaster management plan.

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Annexure-I

Sendai Framework Indicators

A set of 38 indicators was identified to measure global progress in the implementation of the Sendai Framework for Disaster Risk Reduction. The indicators will measure progress in achieving the global targets of the Sendai Framework, and determine global trends in the reduction of risk and losses.

Global target A: Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortalities between 2020-2030 compared with 2005-2015.

A-1 (compound)	Number of deaths and missing persons attributed to disasters, per 100,000 population.
A-2	Number of deaths attributed to disasters, per 100,000 population.
A-3	Number of missing persons attributed to disasters, per 100,000 populations.

Global target B: Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared with 2005-2015.

B-1 (compound)	Number of directly affected people attributed to disasters, per 100,000 population.
B-2	Number of injured or ill people attributed to disasters, per 100,000 population.
B-3	Number of people whose damaged dwellings were attributed to disasters.
B-4	Number of people whose destroyed dwellings were attributed to disasters.
B-5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

Global target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.

C-1 (compound)	Direct economic loss attributed to disasters in relation to global gross domestic product.
C-2	Direct agricultural loss attributed to disasters.
C-3	Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.
C-4	Direct economic loss in the housing sector attributed to disasters.
C-5	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters.
C-6	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

Global target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

D-1 (compound)	Damage to critical infrastructure attributed to disasters.
D-2	Number of destroyed or damaged health facilities attributed to disasters.
D-3	Number of destroyed or damaged educational facilities attributed to disasters.
D-4	Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters. *The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States.*
D-5 (compound)	Number of disruptions to basic services attributed to disasters.
D-6	Number of disruptions to educational services attributed to disasters.
D-7	Number of disruptions to health services attributed to disasters.
D-8	Number of disruptions to other basic services attributed to disasters.

Global target E: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

E1	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.
E2	Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies.

Global target F: Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.

F-1	Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions.
F-2	Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided by multilateral agencies.
F-3	Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided bilaterally.
F-4	Total official international support (ODA plus other official flows) for the transfer and exchange of disaster risk reduction on-related technology.
F-5	Number of international, regional and bilateral programmes and initiatives for the transfer and exchange of science, technology and innovation in disaster risk reduction for developing countries.
F-6	Total official international support (ODA plus other official flows) for disaster risk reduction capacity-building.
F-7	Number of international, regional and bilateral programmes and initiatives for disaster risk reduction-related capacity-building in developing countries.
F-8	Number of developing countries supported by international, regional and bilateral initiatives to strengthen their disaster risk reduction- related statistical capacity.

Global target G: Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

G-1 (compound G2-G5)	Number of countries that have multi-hazard early warning systems.
G-2	Number of countries that have multi-hazard monitoring and forecasting systems.
G-3	Number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms.
G-4	Percentage of local governments having a plan to act on early warnings.
G-5	Number of countries that have accessible, understandable, usable and relevant disaster risk information and assessment available to the people at the national and local levels.
G-6	Percentage of population exposed to or at risk from disasters protected through pre-emptive evacuation following early warning.

Annexure-II

Do's and Don'ts

Fire

Do's:

a. Keep your first aid box ready and replace expired medicines.
b. Keep your fire detection system in healthy condition and in auto mode.
c. Keep your firefighting system in healthy condition and in auto mode.
d. Check the healthiness and maintain portable fire extinguishers on quarterly basis.
e. Keep portable fire extinguishers as per the area requirement i.e.
    - 'A' type (effective against fires involving paper, wood, textiles, and plastic)
    - 'B' type (effective against flammable liquid fires i.e. cooking liquids, oil, gasoline, kerosene),
    - 'C' type (for fires in "live" electrical equipment),
    - 'CO_2' type (highly effective fighting B and C class of fires).
f. Mark emergency exit route to be followed during emergency.
g. In case of fire is detected:
    - Activate the nearest fire alarm (Hooter).
    - In case of fire on electrical equipment, cut off the energy supply/ isolate the equipment/ area.
    - Inform in-charge of the establishment.
    - Notify the local Fire Department by calling.
    - Notify Ambulance to rescue the affected persons.
    - If the fire alarm is not available, notify the site personnel about the fire emergency by the following means (check applicable):
        - PA System
        - SMS communication
        - Voice
        - Phone Communication
    - Fight the fire using available Fire Extinguishing equipment like Emulsifier systems, Hydrant systems, and portable fire extinguishers.
    - Evacuate the affected area through designated exit routes.
    - Follow the instructions given over the public address system.
    - If there is smoke, crawl out of the building.
    - Go directly to the assembly point.
    - Perform an accurate head count of personnel reported to the designated area.
    - Determine a rescue method to locate missing personnel.

- Provide the Fire Department personnel with the necessary information about the facility.
- Remain at safe place until the competent authority (Designated Official or designee) announces that it is safe to re-enter.

h. **If you are trapped in a fire:**
   - Call for help and stand in a visible place.
   - Stand near a window so that you can be seen.
   - Indicate your location and the situation.
   - Open a window in order to breathe better.

i. **If you require to open the door in fire affected area:**
   - First, ascertain whether it is hot or smoke is seeping in around the edges.
   - Use the back of your hand to feel the temperature at the upper and lower parts of the door.
   - If the door is hot or smoke is visible, do not open it. Find another way out or another evacuation route.
   - If the door is cool, use your foot as a stopper as you slowly open it.
   - If the smoke is hot and it is difficult to breathe:
     - Get down near the ground! The air will be cooler and cleaner there.
     - If possible, cover your nose and mouth with a wet cloth.

Don'ts:

a. Don't smoke in switchyards, stores, control rooms, office complexes etc.
b. Don't block passage with material/ other items
c. Don't close/ lock designated exit routes.
d. Don't use lifts/ elevators during fire emergency
e. Don't stop at or near the exit. Leave the way free for other people evacuating the building.
f. If your clothes catch fire, lie down and ROLL across the floor to smother the flames. Do not run, as this will fan the flames.

Earthquake

1. When you are inside the building during Earth Quake:

Do's:

a. Inform all employees to assemble at designated assembly points through PA system/ Alarm.
b. Stay away from glass, windows, building, outside doors and walls, and anything that could fall, (such as lighting fixtures or furniture).
c. Switch off power supply to avoid electrocution due to falling electrical fixtures.
d. All employees to gather at the designated assemble point outside the building.

e. HR Department to do the head count.
f. First aid desk shall be arranged near assembly point and call emergency van to rush casualties, if any, to nearby hospital.

Don'ts:

a. Do not rush outside in hurry without analysing the situation.
b. Do not use lifts/ elevators during Earthquake

2. When you are outside the building during Earth Quake:

Do's:

a. Stay outside until the shaking stops. The greatest danger exists directly outside buildings; at exits; and alongside exterior walls.
b. Stay away from glass, windows, building, outside doors and walls, trees, streetlights, and utility wires and anything that could fall.

3. When you are in a moving vehicle

Do's:

a. Stop as quickly as safety permits and stay in the vehicle.
b. Proceed cautiously once the earthquake has stopped.

Don'ts:

a. Don't stop near or under buildings, trees, overpasses, and utility wires.
b. Don't use roads, bridges, or ramps that might have been damaged by the earthquake.

4. When you are trapped under debris:

Do's:

a. Keep patience, don't panic.
b. Cover your mouth with a handkerchief or clothing.
c. If mobile communication is available, inform your location to your friends/ relatives. It will help the rescue team.
d. Tap on a pipe or wall so rescuers can locate you.
e. Use a whistle if one is available.
f. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.
g. Preserve water/ dry food items available with you to survive till rescue team arrives.

Don'ts:

a. Do not light a match.
b. Do not move about or kick up dust.

Cyclone

Preventive/ precautionary measures:

a. Keep all tower drawings, hardware drawings, tower schedules etc. readily available.
b. Keep towers, conductors, hardwares, insulators, Earthwire etc. as per inventory norm.
c. Keep towers in complete shape. Any shortage of tower parts can result in unnecessary panic at the time of use.
d. Keep your T&P as per norms and in working condition.
e. Check healthiness of T&P immediately after its last use.
f. Repair/ replace defective T&P.
g. All issues and receipts of material are to be done using ERP system to have updated information of inventories.
h. Maintain rate contract for transportation of material for immediate shifting of material in case of exigency.
i. Take immediate action for replenishment of damages/ shortages.
j. Keep updated list and contact information of heavy equipment (like Cranes, Excavators, Gas cutters, Concrete breakers, Tractors & Trolleys etc.) providers available in your area.
k. Keep updated list and contact information of skilled fitter contractors to deploy them at very short notice.
l. Keep updated list and contact information of tower manufacturers, erectors operating in your region.

When cyclone alerts and warnings are on:

a. Keep continuous vigil on movement of cyclones.
b. Check your inventories at places near to likely cyclone affected areas.
c. Transport additional inventories, if required, to meet the expected exigency.
d. Send satellite phones and deploy expert manpower to the nearest station of likely cyclone affected area.
e. Contact the heavy equipment provider/manufacturers/ contractors and get the information regarding availability of man and material required so that they can be immediately mobilised thereafter according to the priority and likely severity of the cyclone.
f. Only one group should call the truck drivers which are transporting the material as it becomes irritating for them to receive phone calls and also due to battery constraints.
g. Keep required quantity of Diesel to run Substation DG set continuously for 7 days at Substations which are likely to be affected by the cyclone.

h. Keep fuel tanks full of the vehicles being used at Substations which are likely to be affected.

Post-cyclone measures:

a. Deploy a team to thoroughly inspect the affected area to prepare first information report.
b. Mobilise the available resources.
c. Deploy required heavy equipment like cranes, gas cutters, excavators, Concrete breakers, DG sets for illumination, trucks, tractors with trolleys, jeeps etc. from locally available resource providers.
d. Provide additional resources as required by first information report.
e. Form a committee for finalization of service contracts, on spot purchase of required material etc.
f. Making necessary arrangements for lodging, boarding for the additional manpower being deputed from other sites.
g. Making necessary arrangements for food & water at site.
h. Designated finance officer to camp at site/ nearest substation for day to day payments.
i. Establish temporary stores at affected site to receipt and issue of materials at site.
j. Deploy round the clock security guard at stores and affected sites to avoid pilferage/ theft of material.
k. Submit reports of restoration work progress daily.

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Annexure-III

Contact Detail of Emergency Services in case of any Disaster

Emergency Services	Contact Details
Emergency Services - (Telephone Numbers) NLDC/NRLDC -Delhi (STD Code: 011)	
Medical Services	
Ambulance	102
Sitaram Bhartiya	42111111
Rockland	47667100, 41222222
Fortis(Vasant Kunj)	42776222
Blood Banks	
AIIMS - Aurobindo Marg, New Delhi	26588700, 26588500
Indian Red Cross Society II, Red Cross Road, New Delhi-1100001	23716441/2/3
Police Services	
Police	100
Police Station Vasant Vihar	26152577, 26152699
Bomb Disposal Squads	
South West	26152810/801
New Delhi	23361231 Extn. 3705
Delhi	22512201 Extn. 577
North	23962281
Fire Services	
Fire Services	101
EPABX Board-DFS (HQ)	23412222-26
DISASTER MANAGEMENT CONTROL CENTER	
Control Room (Delhi Govt)	1077
Emergency Services - (Telephone Numbers) -ERLDC Kolkata (STD Code:033)	
POLICE	
Police	100
Lalbazar Police Control	22143024, 22143230, 22141310
Jadavpur Police Station	24730146, 24994580
Fire Brigade	
Fire Brigade	101
Fire Services Deptt.	252 1165, 2252 6164, 2252 3170, 2252 2222 - 8 (7 lines), 2227 6666

Ambulance	
Dhakuria Club Samanway Samiti	24154934
Hazra Medical Stores	24495794/6993
Jadavpur Byabassayi Samity	28670132
Central Blood Bank	8373036521
Hospitals	
Calcutta Medical Research Institute	24567700 / 3090 3090
Kothari Medical Centre	24567050 - 59, 40127000, +91 86977 08132
Peerless Hospital	4011 1222, 2432 0075 / 4989, 2462 2394
B M Birla Heart Research	4088 4088, 4088 4000
AMRI Hospital, Dhakuria	668 00 000
AMRI Hospital, Salt Lake	668 00 000
Apollo Gleangles Hospital	4420 2122
R N Tagore Inst. of Cardiac Science	186 0208 0208, +91 9903 335544
Emergency Services - (Telephone Numbers) SRLDC- Bangalore (STD Code: 080)	
Medical Services	
Mallaya Hospital, Vittal Mallya Road	080 22277979/22277997
Manipal Hospital, Old Airport Road	080 22221111
St. John's Hosptial	080 22065000 / 5001
Baptist Hospital, Hebbal	080 22024700 / 46404700 , +91 9448496602
Columbia Asia, Hebbal	080 66600666 / 41791000
Columbia Asia, Yeshwanthpur	080 61656262
Sagar Hospital, Banashankari	080 4299999/ 42888100 / 42999100
Sagar Hospital, Jayanagar	080 4288888/ 42888100 / 42999100
Narayana Hrudayalaya,Bommasandra	1800 4250 4250 / 080 66660655-0658 / 9902 821128
Narayana Nethralaya, Rajaji Nagar	080 66121641 / 66121643 / 9902546046
Narayana Nethralaya, Bennarghetta Road	080 66121618 / 66121619, 9513522400, 9538822400
Apollo Hospital, Near Mantri Mall, Seshadripuram,	080 4668 8888 / 8999/ 8098 / 8097
Apollo Hospital, Bannerghatta Road	080 26304050 / 4051
Blood Bank	
Indian Red Cross Society-Blood bank-Race course road	080 (O) 22264205, 22268435
Police Services	
Police -Control Room	100
High Grounds Police Stn	080 22942587 / 2083

Fire Services	
Fire -Toll Free No.	101
Fire Service Control Room	080 22971500 / 1550 / 1600
Fire-Wireless Operator	080 22971571
Other Emergency Services	
Ambulance	102 or 108
Central Control Room	080 22971500 / 1537
Karnataka State Bomb Disposal Squad	080 - 22212743, 22942493, 22942333, 100
Karnataka State Natural Disaster Monitoring Cell	080 67355000
Karnataka State Disaster Management Authority	080-22032582, 080-22253707, 080-22032416
Emergency Services - (Telephone Numbers) WRLDC- Mumbai (STD Code:022)	
Medical Services	
Ambulance Services	102/1298
Andheri Vyapari Mitra Mandal	022 2832 0021/26, 02228386408/91-22-28320021, 28320026
Bombay Hospital	022 22067676, 40511111
Bhagvati Hospital	022 28932461/62/63-Extn-105
Cooper Hospital	022 26207254/56/58 Extn-263
Hospitals	
Hiranandani powai	022 25763322 / 3323 , 022 71023322 / 3323
Fortis Mulund	022 43654365, +91 9606 047 050, Emergency No. 022-41114111
Nanavati Vile Parle(W)	022 26267500
Tata Hospital (Parel)	022 4146750-55 / 24177000
Lilavati hospital	022 26568063/64/Ambulance 9769250010 / 7506358779
Holy Spirit Mahakali caves Andheri(E)	022 42478888, 8828112323
Blood Bank	
Breach Candy Hospital and Research Centre	02223667811 / 7820
Hinduja National Hospital & Medical Research	022 24452222, 24451515
Jaslok Hospital And Research Centre	022 40173434
Lilavati Hospital Blood Bank	022 68658215
Tata Memorial Hospital Blood Bank	022 4146750-55 / 24177000
Nanavati Vile Parle(W)	022 26267500

Bhagwati Blood Bank (Borivali)	022 8932461/2/3
Bombay Hospital (Marine Lines)	022 2067676 / 40511111
Holy Spirit Hospital (Andheri)	022 42478888, 8828112323
Police Services	
Commissioner of Police, Mumbai	022 22620826
Police Control Room (Mumbai City)	022 22621855, 22621983, 22625020, 22641449, 22620111
Mumbai airport	022 26156315/26716309,26156921
Andheri (East)	022 26831562/26831447
M.I.D.C.	022 28368352/28394205,28361324
Oshiwara	022 26323861/26323862
Sakinaka	022 28523936/28522334/28476160/28474411
Women Help Line	103 & 022 22633333/22620111
Fire Stations	
Fire Brigade Control Room	022 23085991/23085992/23085993/23085994/101
Mumbai Fire	101 /022 23076111 / 23086181 / 23074923 / 23076112 / 13
Thana Fire	101 & 022 25391600
Vashi Fire	101 & 022 27660101
Marol , Andheri (E)	022 29200940/1, 821 0940/41
Disaster Management Control Centers	
MCGM Disaster Management Control Room	108
Disaster Management Control Room (Maharashtra)	022-22027990
BMC – Disaster Control Room	1916, 022 22694725 / 22694727 / 22704403
Bomb Disposal Squads	
Bomb Detection & Disposable Squad	022 22080501
Bomb Detection & Disposable Squad	022 22650707
Bomb Blast.Cell	022 22620935
Emergency Services - (Telephone Numbers) NERLDC- Shillong (STD Code: 0364)	
Medical Services	
Ambulance	
Ambulance Central	108
Ambulance - Others	0364 2224100 / 9862041178
Hospitals	
Woodland Hospital, Dhankheti	0364 2224885 / 2225240 / 2500472 / 2502711

Bethany Hospital, Opp. Nagaland House, Nongrim Hills	0364 2520300 / 2522979
Neigrihms	0364 2538014
Nazareth Hospital, Laitumkrah	0364 2210188 / 2224052
Civil Hospital, Laban	0364 2224100
Blood Banks	
Blood Bank, Neigrihms	0364 2538014 / 2538025 / 2538013
Blood Bank, Nazareth Hospital, Laitumkrah	0364 2224052
Police / Fire Services	
Police Central	100
Police Control Room, Shillong	0364 22222214 / 22222215
DGP, Shillong	0364 2220115 / 2224879
Police Station, Rynjah	0364 2230402
Fire	
Fire Service Central	101
Fire Brigade Main	0364 2227700/2222000
Fire Brigade Nongthymmai	0364 2223300
Electricity	
Electricity	0364 2223050 / 2223778

Annexure-IV

Contact detail of Load Despatch Centres

S. No.	State/UT SLDC	Control Room Contact No.	Fax No/VOIP
1	National Load Despatch Centre (NLDC),Delhi	011-26536832 / 26524522/32026900	011-26524525 /26536901
2	Northern -Regional Load Despatch Centre (NRLDC),Delhi	011- 26519406 / 40224601 / 40224602 / 26853082	FAX: 011-26852747, EPABX: 26854861, 26854015, 40224603
3	Western Regional Load Despatch Centre(WRLDC),Mumbai	022-28203885 /28397634	022-28202630 /28202693
4	Eastern Regional Load Despatch Centre(ERLDC),Kolkata	33 30116900-09 (EPABX) 2423-5875 / 24235265 / 30116990-96 (CONTROL ROOM)	033-24235029 /24235809
5	Southern Regional Load Despatch Centre(SRLDC),Bengaluru	080-22254525 /22252612/22204325	080-22259219 /41136043(Incoming FAX): 080-22351146 (Outgoing FAX)
6	North-Eastern Regional Load Despatch Centre(NERLDC), Shillong	0364-2537470 / 2537482 / 2537486 / 2537427	0364-2537470
NORTHERN REGION			
1	Chandigarh	08054104522 / 0172-2637880	0172-2637880
2	Delhi	011-23221046/99/98	011-23221012 / 23221059
3	Haryana	0180-3203968/69 / 2664095 / 09354152433	0180-2670819
4	Himachal Pradesh	0177-2838398 / 2837649	0177-2837543
5	Jammu	0191-2490905 (J&K) 0194-2494518 / 8491941013 (Bemina)	0191-2490905 (J&K) 0194-2492430 / 31 (Bemina)
6	Punjab	0175-2367711 / 7490 / 09646119318	0175-2365340
7	Rajasthan	0141-2250079 / 5183755 / 2251255	0141-2250073

8	Uttar Pradesh	0522-2287819 / 890 / 818	0522-2286563 / 2287818
9	Uttrakhand	9756702727 /8006454540/ 0135-2645758 / 68 / 6518576	0135-2645758
WESTERN REGION			
10	Chhattisgarh	0788-2282634 / 2282635/07898987528(M)	0788-2282632
11	Dadar & Nagar Haveli & Daman & Diu	0260-2642810/ 0260-2406561 ,562, 563/ 09925605111 (M) 0260-2230535 /09909976436(M)	0260-2642810
12	Goa	0832 2711813 / 0832 2312130 / 08380015202 (M) / 08380015058(M)	0832-2313780
13	Madhya Pradesh	0761 2661500 / 2661600 / 2661660 / 2666800 /2970601/ 09425806598(M)	0761-2664343 / 2970119
14	Maharashtra	022 27601765 / 27601766 / 09819892095/10(M)	022 27601769 / 27602936
15	Gujarat	0265 2352103 / 23531132 / 09879200620	0265 2352019
SOUTHERN REGION			
16	Andhra Pradesh	040-27543689, 8332988612	040-27546635
17	Telangana	040 23317662, 9490153118	040 23393616
18	Karnataka	080-22259719/22371024, 9448365154	080-22282287 / 22971024
19	Kerala	0484-2542484, 9446008888	0484-2556483
20	Puducherry	0413-2330260 / 2341148	0413-2341148
21	Tamil Nadu	044-28521482, 9445857176	044-28545291
EASTERN REGION			
22	Bihar	0612-2504557 /9835036906/2504090 /8986913349	0612-2504557
23	Damodar Valley Corporation	06540-252266/274837/252466	06540-274838

24	Jharkhand	0651-2490090 / 9431135537/2490863	0651-2490486
25	Orissa	0674-2748961/2748417	0674-2748218/2748509
26	Sikkim	03592-250181/ 202927	03592-202927
27	West Bengal	033-26887690 / 26887693 / 26885445 / 9434910598	033-26885445/26886232
NORTH-EASTERN REGION			
28	Arunachal Pradesh	0360-2217438/ 2214359	0360-221435
29	Assam	0361-2382263/ 2381287	0361-2387929
30	Manipur	0385-2451172/ 2436102/103	0385-2450702
31	Meghalaya	0364-2550020/ 2551967	0364-2551967
32	Mizoram	0389-2305964 / 2305589	0389-2305562
33	Nagaland	03862-230118/ 229600	03862-230118
34	Tripura	0381-2356470/ 2357166	0381-2350795

Annexure-V

Contact Detail of Nodal Officers in case of any Disaster

MOP / Grid – India/ NLDC/ RLDC/ SLDC	Name	Designation	Tel. Nos.	Mobile No.	Fax No.	E-mail Address
APTRANSCO, SLDC						
Nodal Officer	A.K.V.Bhaskar	CE (Grid operation)	0866-2429234	9490153116		cegoaptransco@yahoo.com, apsldctransco@gmail.com, vbhaskar@gmail.com, akvbhaskar@gmail.com
Second In Command	Y Anantha Srinivas	SE (Grid Operation)	0866-2429234	9490153134		apsldctransco@gmail.com
Telengana Sldc						
Nodal Officer	S V Kumar Raju	Chief Engineer(SLDC)	040-23317645(O)	9440811105	040-233993616	cesldctelangana@gmail.com
Second In Command	P.Suresh Babu	SE (SLDC)	040-23317645(O)	9440679432	040-23393616	cesldctelangana@gmail.com
Tamil Nadu, Sldc						
Nodal Officer	Er.Samuel Rajasekaren	Chief Engineer/Grid Operation	044-28521509	9445007726	044-28545291	ceogo@tnebnet.org
Second In Command	Er.T.Subbarayan	Superintending Engineer/Load Despatch and Grid Operation	044-28591415	9444960551	044-28545291	seldgo@tnebnet.org, eeshiftsldcchn@gmail.com
Kptcl,Sldc Karnataka						
Nodal Officer	James Philip	CE (SLDC)	080-22267034	9448471411	080-22282287	ceeldckptcl@yahoo.com,sldc.kptcl@gmail.com
Second In Command	Ravi Shankar	SE (SLDC)	080-22259719	9448365073	080-22282287	ceeldckptcl@yahoo.com,sldc.kptcl@gmail.com
Kseb,Sldc Kerala						
Nodal Officer	S R Anand	CE (Transmission and SO), SLDC	0484 - 2555965,2555950	9446008202	0484-2543850	cesoklsy@gmail.com
Second In Command	Judson K Raphael	Dy.CE(Grid),SLDC	0484 2555950	9446008564	0484-2543850	cesoklsy@gmail.com
Government Of Puducherry						
Nodal Officer	T Shanmugam	SE,HOD & System Contrl Center	0413-2334277	9489080301		se1ped.pon@nic.in
Second In Command	Shanmukha vadivel	E E -EHV/System Control Center	0413-2339543	9489080360		eesccedp@yahoo.in
Goa						
Nodal Officer	Stephen Fernandes	Chief Electrical Engineer	0832-2224680	0832-2426986	7719012626	cee-elec.goa@nic.in
Second in Command	Shailesh Burye	Superintending Engineer (Commercial)	0832-2224680	0832-2426986	7350699000	sburye@rediffmail.com
SLDC, KALWA MAHARSHTRA						

Nodal Officer	Juelee Wagh	Chief Engineer SLDC	022-27601762 (O)	022-27601769	9819241773	cesldc@mahasldc.in
Second in Command	Mahesh Bhagwat	SE (Operation)	022-27601755	022-27601769	9920499062	seoperationmsldc@gmail.com
SLDC, Gotri, Vadodara, GUJRAT						
Nodal Officer	A B Rathod	Addl. Chief Engineer (SLDC)	0265-2353171		9925218526	acesldc.getco@gebmail.com
Second in Command	D N Shah	SE (Operation)	0265 - 2352103		9925212832	seopsldc.getco@gebmail.com
Chhattisgarh SLDC, Raipur						
Nodal Officer	K S Manothiya	ED (LD)	0771-2574172	0771-2574173	9826710989	ksmanothiyayks@gmail.com; celdcg@sldccg.com
Second in Command	Sanjay Chowdhary	SE (SO)	0771-2576015	0771-2574173	9340197611, 9893169898	seso@sldccg.com
SLDC, Jabalpur,MP						
Nodal Officer	S S Patel	Addl CE (LD)	0761-27661111 Ext-2733	0761-2664343	9425805270	sspatel_2261@yahoo.com
Second in Command	R K Gupta	Superintending Engineer	0761-27661111 Ext-2754	0761-2664343	9425805182	rajeshgpta@yahoo.co.in
DAMAN & DIU						
Nodal Officer	Milind Ingle	EE (LD)	0260-2408800		9426982023	elec-dmn-dd@nic.in
Second in Command	Dilesh Solanki	Asst. Engineer	0260-2408816		9978761414	ed-jetech-dd@nic.in, ed-aesldc-dd@nic.in
Dadar and Nagar Haveli						
Nodal Officer	H M Patel	EE (Trans)	0260-2642921	0260-2642338	9924127039	hmpatel39@gmail.com
Second in Command	Vaishali Verma	A.E. (SLDC)	0260-2406509		9426868777	vrverma.sldc@gmail.com
SLDC OPTCL						
Nodal Officer	B.B Mehta	Director (SLDC)	0674-2748256	9438907008		dir.sldc@sldcorissa.org.in
SLDC West Bengal						
Nodal Officer	Goutam Nayak	C.E.		9434910030		ce.sldc@gmail.com
SLDC Ranchi, Jharkhand						
Nodal Officer	Manoj Kr Karmali	ED, Operations		8987581081		edoperationjusnl@gmail.com
Alternative Person	Shailesh Prakash	DGM, SLDC		8809972570		sldcranchi@gmail.com
SLDC Patna, Bihar						
Nodal Officer	A K Chaudhary	SLDC incharge		7763817705		sldc.bseb@gmail.com
Alternative Person	Kumar Prasant			7763817717		-
SLDC Damodar Valley Corporation						
Nodal Officer	Sudipta Mitra	DCE	033-2688-5079	8910222861		dvcsldc@gmail.com
SLDC Sikkim						
Nodal Officer	Dinesh Kharel	C.E.		7797756309		acepowersikkim@gmail.com
SLDC Jammu and Kashmir						
Nodal Officer	Sandeep Seth	CE JPDCL Jammu erstwhile M & RE Wing Jammu	0191-2554426	9419189832	0191-2505708	cedistributionjpdcl@gmail.com
Nodal Officer	Javaid Yousuf Dar	CE KPDCL Kashmir erstwhile M & RE Wing Kashmir	0194-2477221/2452001	9419003485	0194-2484667	ce.mre.kash@gmail.com
Nodal Officer	Bavinder Kundal	CE JKPTCL Jammu erstwhile S&O Wing	0191-2476172	9419192181		sojpdd@gmail.com , jksldc1@gmail.com

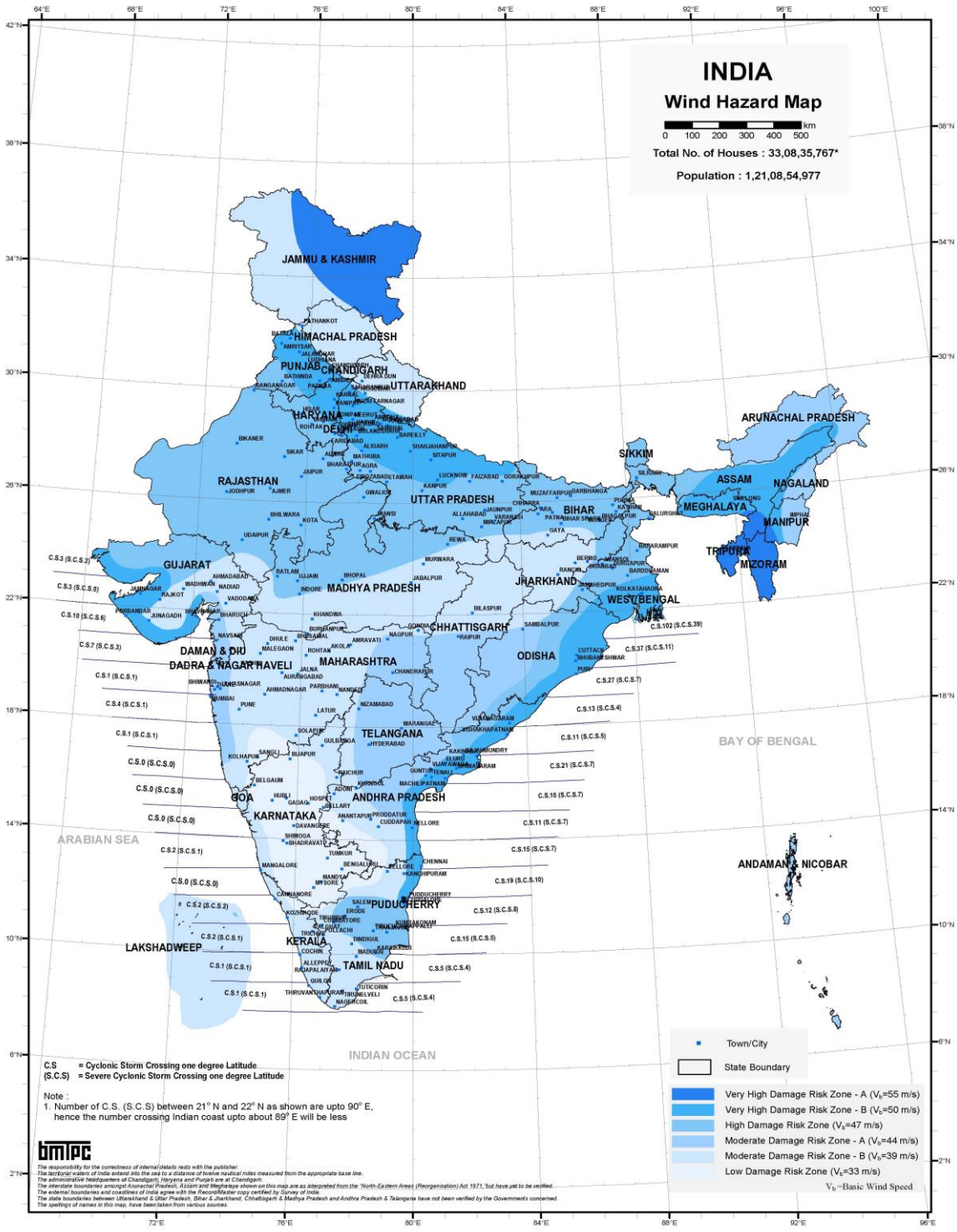
		Jammu PDD				
Nodal Officer	Hashmat Qazi	CE JKPTCL Kashmir erstwhile S&O Wing Kashmir PDD	0194-2491340	9419008002	0194-2494125	dosokashmir@rediffmail.com
Second in Command	Tejinder Pal Singh	EE Division(Commercial) Jammu erstwhile LDM&T Division Jammu		9419143364		tpssalaria@gmail.com, ldmtdivisionjammu@gmail.com
Second in Command	Ms Aaquib Deva	EE System Operations Division Kashmir erstwhile LDM&T Division Kashmir	0194-2492431	9419753008		ldmtkmr@gmail.com
SLDC PUNJAB						
Nodal Officer	Er. Arvinder Pal Singh	CE (SLDC)	0175-2653660	9646118001	0175-2365340	ce-sldc@pstcl.org
Second in Command	Er. Kuldeep Singh	SE (SLDC/Operation)	0175-2366074	9646118004	0175-2365340	se-sldcop@pstcl.org
SLDC Bhakra Beas Management Board						
Nodal Officer	Narendra Sharma	Director (Power Regulation)	0172-2652820	9417216047	0172-2652820	dirpr@bbmb.nic.in
Second in Command	Amandeep Singh	Sr. XEN/ Add. SE (Power Controller)	0172-2659324	9478200223	0172-2652820	powerc@bbmb.nic.in
SLDC CHANDIGARH						
Nodal Officer	Deelip Kumar	APC	0172-2637880	8054104512	0172-2637880	apc.chandigarh@gmail.com
SLDC DELHI						
Nodal Officer	Mr. M. A Khan	GM (SLDC)	011-23221091	9999533670	011-23221069	alikhanmushahid@yahoo.com
Second in Command	S.K.Sinha	DGM (SO)	011-23221175	9999533673	011-23221069	sk.sinha@dtl.gov.in sinha.surendra123@gmail.com
SLDC HARYANA						
Nodal Officer	Neeraj Ahuja	Chief Engineer (SO)	0172-2560547	9316372930	0172-2560622	cesocomml@hvpn.org.in
Second in Command	N.K.Makkar	EE (LD & PC)	0180-2661515	9350278204	0180-2670819	sldcharyanacr@gmail.com
SLDC Himchal Pradesh						
Nodal Officer	Er. Ashwani Kumar Sood	Chief Engineer, SLDC	0177-2837649	82196-58014	0177-2837543	cehpsldc@gmail.com
Second in Command	Er. Desh Raj	SE,SLDC	0177-2837662	9418113555	-	sehpsldc@gmail.com, pchpsldcshimla@gmail.com
SLDC RAJASTHAN						
Nodal Officer	S.C.Sharma	CE (LD)	0141-2251601	9414061067	0141-2251601	ce.ld@rvpn.co.in
Second in Command	Sona Shishodia	SE (SOLD)	0141-2250403	9414030303	0141-2250073	se.ldrvpnl@rvpn.co.in
SLDC Uttar Pradesh						
Nodal Officer	Emaddudin Khan	CE (Power System Operation)	0522-2722861	9839842532		cepso@upsldc.org
Second in Command	Arshad Jamal Siddiqui	SE(System operation)	0522-4101810	9415609363	0522- 2286563	sesc@upsldc.org
SLDC UTTARAKHAND						
Nodal Officer	Deep Sah	CE	0135-2645758	7088117906	0135-2645758	deep_sah@ptcul.org
Second in Command	Anupam Sharma	SE	0135-2645758	7088117920	0135-2645758	sldc1@rediffmail.com,se_sldc@ptcul.org

Arunachal Pradesh SLDC						
Nodal Officer	N. Perme	Superintending Engineer(SLDC)	-	9436288643	-	se.sopsc@gmail. com
Second in Command	Sange Phuntso	EE, SLDC	-	8974170896	-	eesldcitaap@gmail.com
Assam/ AEGCL SLDC						
Nodal Officer	Ashutosh Bhattacharjee	DGM, LOGISTICS	-	94353-32928	-	dgmlogistic.sldc@aegcl.co.in
Second in Command	Rachael H.Pakhumate	AM	-	6002256402	-	hmar.rachael7@gmail.com
Manipur SLDC						
Nodal Officer	N Jashobanta Singh	GM (SLDC)	0385-2436177	70854 31282	-	gmsldcmanipur@gmail.com
Second in Command	Laishram Ritu	DGM (System Operation), SLDC	0385-2436192	9612882984	-	redrit03@gmail.com
Meghalaya/ MeSEB SLDC						
Nodal Officer	T.Gidon	Executive Engineer, SLDC	-	6009094044	-	gidon@rediffmail.com
Second in Command	David J. Lyngdoh	Executive Engineer (SM), SLDC	-	8259072889	-	david.jeremy6@gmail.com
Mizoram SLDC						
Nodal Officer	J. H. Laithangliana	Superintending Engineer, MSLDC	-	9436143705	-	msldc.circle@gmail.com
Second in Command	H. Lalruatkima	Executive Engineer, MSLDC	-	9862925462	-	sldc_mizoram@rediffmail.com
Nagaland SLDC						
Nodal Officer	Er. Nitovi A Wotsa	Executive Engineer (Transmission & SLDC)	-	9436004928	-	nitoviw@gmail.com
Second in Command	Er. Arenlong Jamir	Sub-Divisional Officer (SO)	-	8731981268	-	arenlongjamir21@gmail.com
Tripura SLDC						
Nodal Officer	Anil Debbarma	DGM, SLDC	0381-2356470	7005709452	0381-2350795	anildebbarma123@gmail.com
Second in Command	Tarak Lal Saha	Manager, SLDC	-	9436925958	-	saha.taralal24@outlook.com

Annexure-VI

Contact Detail of Senior officers of Ministry of Power, Central Power Sector Undertakings, Grid Controller of India and Regional Power Committees for Disaster Management in Power Sector

MOP/ Grid – India/NLDC/ RLDC/SLDC	Name	Designation	Tel. Nos.	Mobile No.	Fax No.	E-mail Address
Ministry of Power	Alok Kumar	Secretary	011- 23710271 / 23711316			secy-power@nic.in
Ministry of Power	Ghanshyam Prasad	Joint Secretary	011-2371-0389			g.prasad67@nic.in
Grid – India	S. R. Narasimhan	CMD	011-26852843		011-26524525/ 26536901	cmd@posoco.in
NLDC						
Nodal Officer	Debasis De	ED	011-26522063	9560665333	011-26524525	debasis.de@posoco.in
Second in Command	S Banerjee	CGM		9433041823		surajit.banerjee@posoco.in
NRLDC						
Nodal Officer	R.K. Porwal	CGM(I/C)	011-65515567	9871581133	011-26536901	rk.porwal@posoco.in
Second in Command	Alok Kumar	GM (SO)	011-26851754	9999039321	011-26853082	alok.kumar@posoco.in
WRLDC						
Nodal Officer	Pushpa S	Sr. GM (GM/SO-II)	022-28395200	022-28235434	9869404482	pushpa@posoco.in
Second in Command	Mahesh Mehandale	Sr. GM (LO)	022-28202691	022-28235434	9422811701	mehendale@posoco.in
ERLDC						
Nodal Officer	Amaresh Mallick	CGM(S0/SS)		9436302720		amareshmallick@posoco.in
Second in Command	Saurav Kumar Sahay	Chief Manager (SO)		9432013173		saurav.sahay@posoco.in
SRLDC						
Nodal Officer	S.P.Kumar	ED, SRLDC	080-22250047	9449599163	080-22259219	spkumar@posoco.in
Second in Command	M.K.Ramesh	CGM (Grid Management)	080-41136040	9449599174	080-22259219	mkramesh@posoco.in
NERLDC						
Nodal Officer	Nabarun Roy	ED, NERLDC	-	9869080265	-	nroy@posoco.in
Second in Command	S.C De	Sr. GM (Post-Despatch, NERLDC)	-	7005540616	-	scde@posoco.in



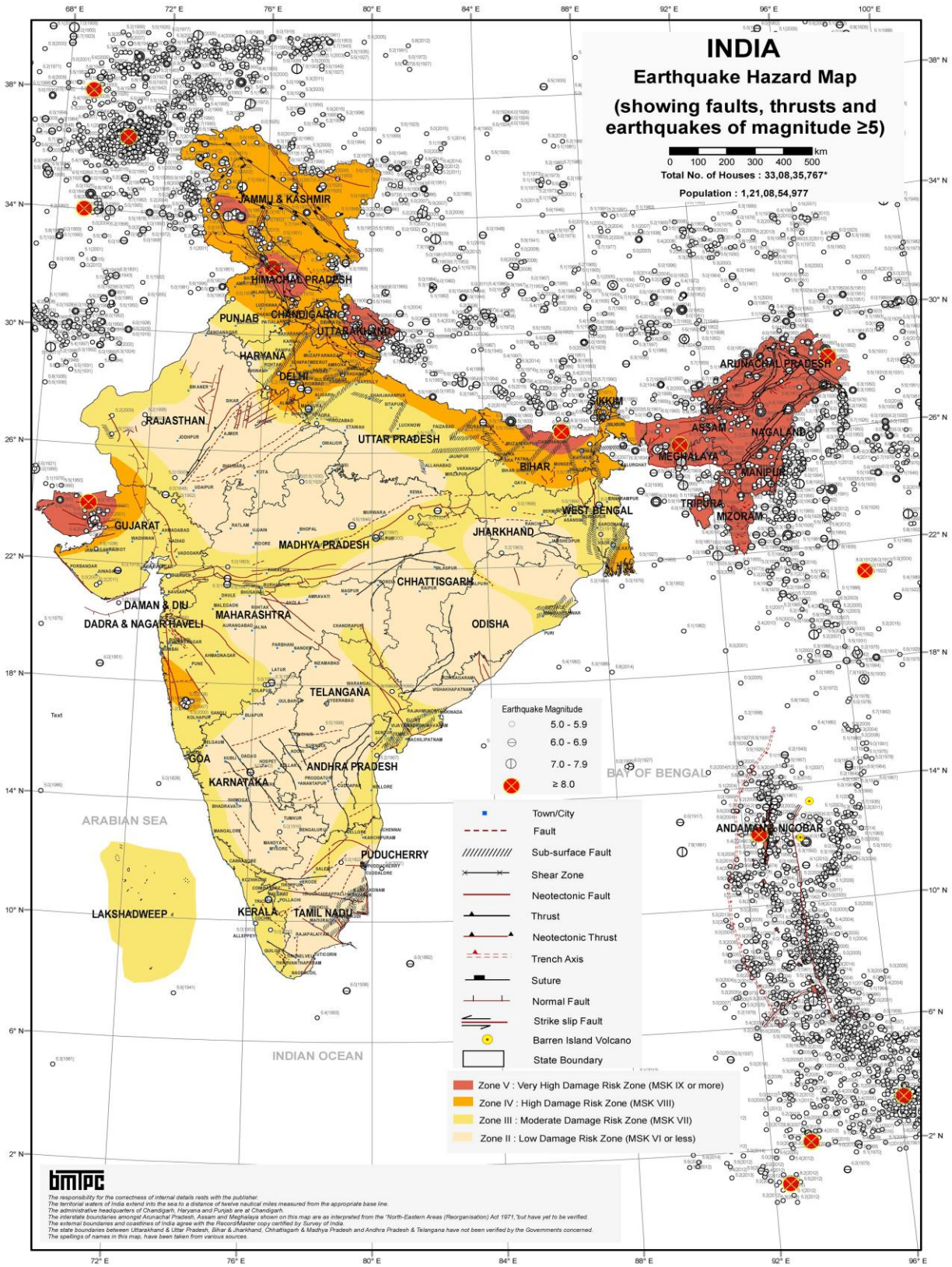
BMTPC : Vulnerability Atlas- 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Basic Wind Speed Map National Building Code: 2016; Cyclone Data, 1891-2015, IMD, GOI. Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Wind Hazard Map of India

BMTPC : Vulnerability Atlas - 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Census of India 2011; Flood Atlas (1987),Task Force Report (2004), C.W.C., G.O.I. Houses/Population as per Census 2011; * Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Flood Hazard Map of India

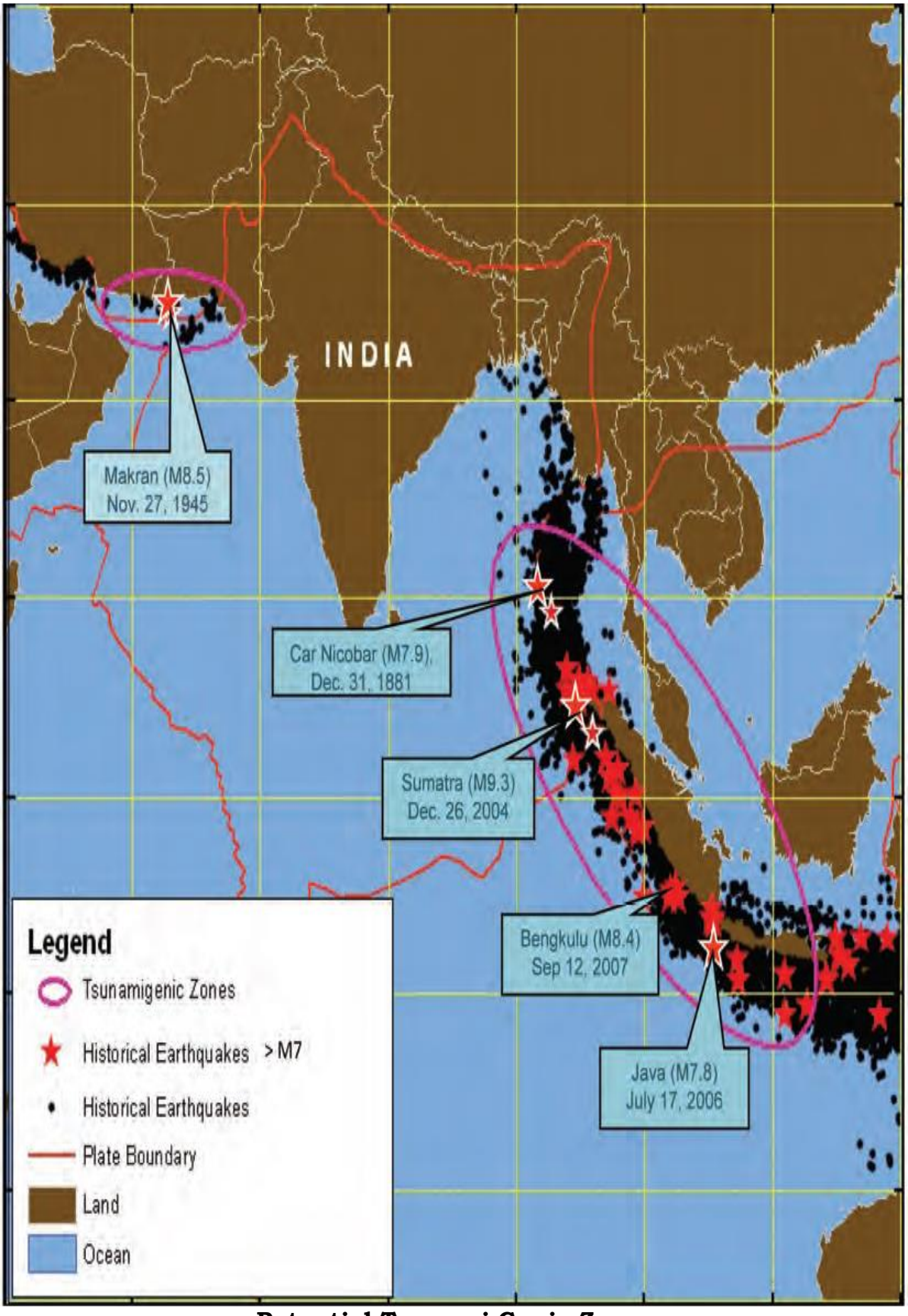
Appendix -III



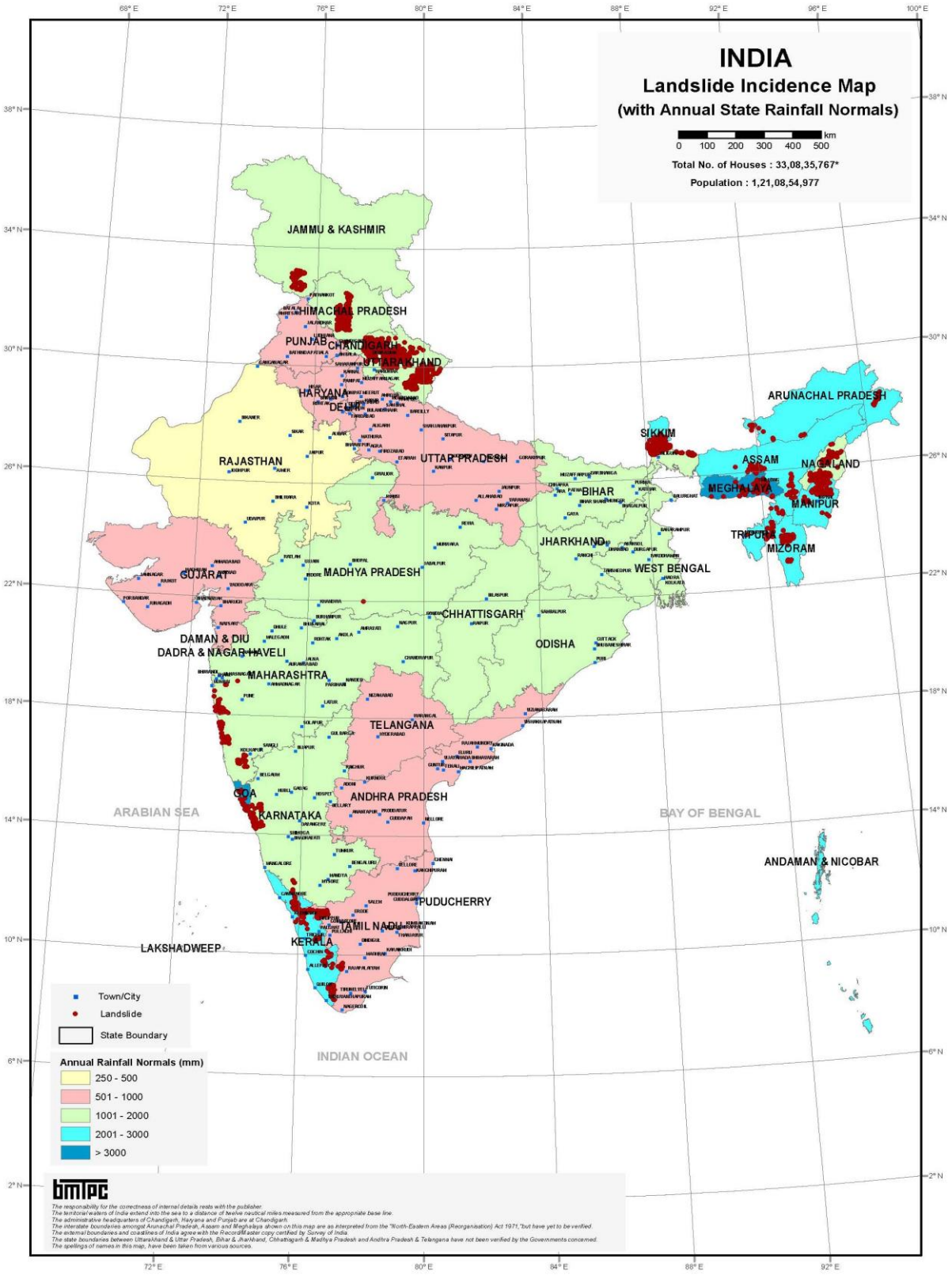
BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Earthquake Hazard Map of India

Appendix-IV



Potential Tsunami Genic Zones



BMTPC: Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA,GOI: Map is Based on digitised data of SOI; Landslide Incidence data GSI; Annual Rainfall data IMD. Houses/Population as per Census 2011;
* Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Landslide Hazard Zones in India

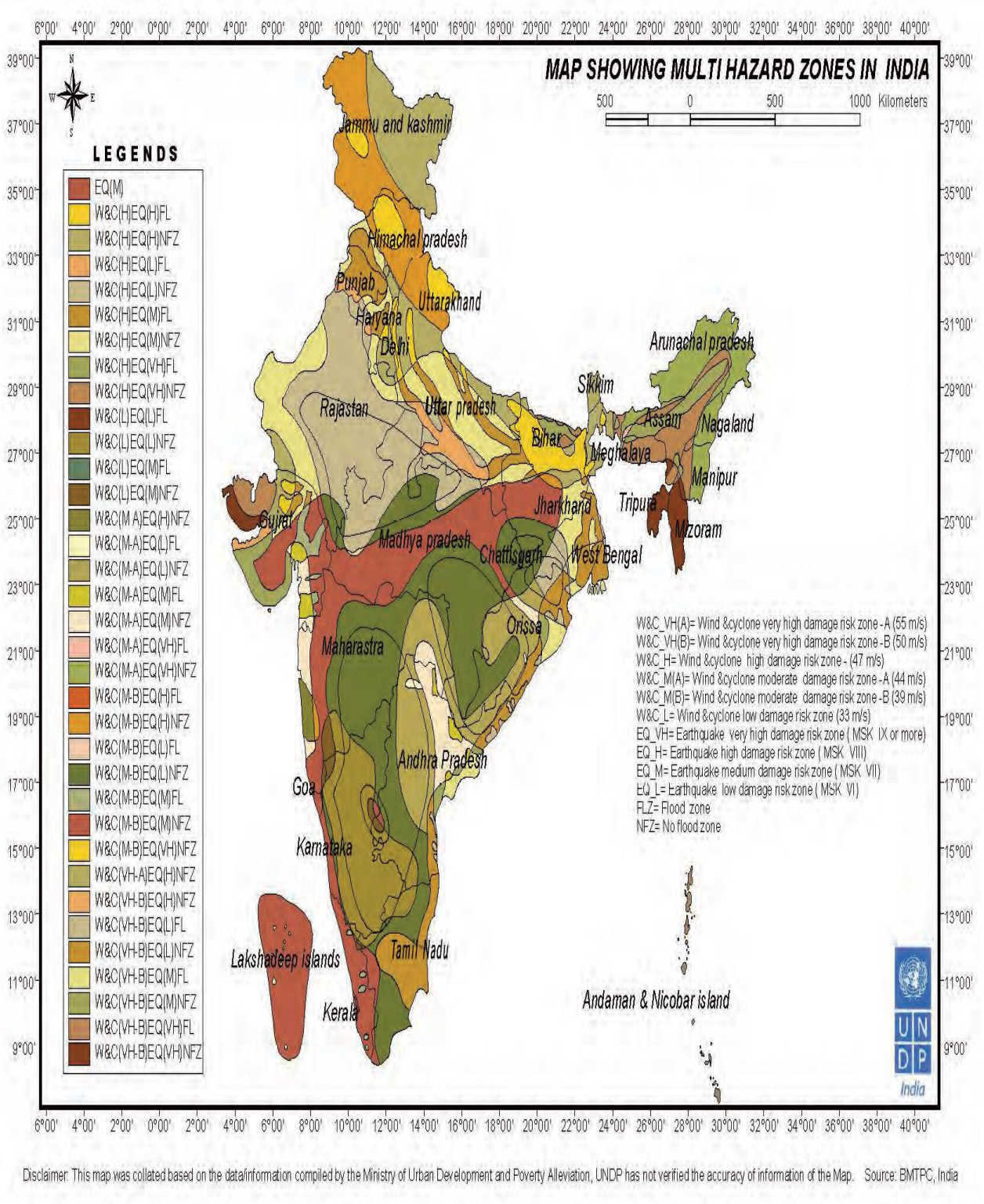
BMTPC: Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI;Thunderstorm data from IMD. Disclaimer: The maps are solely for thematic presentation.

Thunderstorm Incidence Map of India

Appendix-VII

High Risk Multi-hazard zone of India

Appendix-VIII



Multi Hazard Zone of India

Glossary of Key Terms

Adaptation: The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities.

Building Code: A set of ordinances or regulations and associated standards intended to control aspects of the design, construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage.

Capacity: The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals.

Capacity Development: The process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvement of knowledge, skills, systems, and institutions.

Climate Change: (a) The Inter-Governmental Panel on Climate Change (IPCC) defines climate change as: "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use".

(b) The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

Coping Capacity: The ability of people, organizations, and systems using available skills and resources to face and manage adverse conditions, emergencies, or disasters.

Critical Facilities: The primary physical structures, technical facilities and systems which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency.

Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster Risk: The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Disaster Risk Management: The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster Risk Reduction: The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Early Warning System: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Emergency Services: The set of specialized agencies that have specific responsibilities and objectives in serving and protecting people and property in emergency situations.

Environmental Degradation: The reduction of the capacity of the environment to meet social and ecological objectives and needs.

Forecast: Definite statement or statistical estimate of the likely occurrence of a future events or conditions for a specific area.

Geological Hazard: Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hydro-Meteorological Hazard: Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Land-use Planning: The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses.

Mitigation: The lessening or limitation of the adverse impacts of hazards and related disasters.

Non-structural Measures: Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.

Preparedness: The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Prevention: The outright avoidance of adverse impacts of hazards and related disasters.

Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Response: The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Retrofitting: Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards.

Risk: The combination of the probability of an event and its negative consequences.

Risk Assessment: A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

Risk Management: The systematic approach and practice of managing uncertainty to minimize potential harm and loss.

Risk Transfer: The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.

Structural Measures: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems.

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.