



TRAINING MANUAL

Protection against Lightning



Nepal Preparedness Partnership
Kathmandu, Nepal
January 2020

BILL & MELINDA
GATES *foundation*



Training Manual
for Protection against Lightning (PaL)

© ADPC 2019
Bangkok, Thailand

For more information, please contact app@adpc.net

Preface

ADPC, with support from the Bill and Melinda Gates Foundation (BMGF), is undertaking the project “Strengthening Emergency Response Capacity of Government, Private Sector and Local Humanitarian Actors in Asia” to improve emergency preparedness, response, and recovery from disasters in Asia. The program aims to improve the humanitarian response to disasters by strengthening the interface between national governments, local humanitarian organizations, the private sector, academia, and the media. To address issues of coordination and knowledge exchange, the Asian Preparedness Partnership (APP) has been formed at the regional level for strengthening preparedness for emergency response.

For the implementation of the program at the country level in Nepal, the Nepal Preparedness Partnership (NPP) was established, which is comprised of governments (federal and local), local humanitarian organizations, the private sector, and academic institutions. The program focuses on three key areas: 1) humanitarian coordination, 2) capacity building, and 3) knowledge generation and sharing with all stakeholders. Capacity building activities have been organized in partnership with the government, private sector and local humanitarian organizations by NPP, and aims to increase understanding and knowledge of all levels of disaster risk management.

This manual has been developed as a component of the overall standardized training package for capacity development. The intent of this training manual is to develop an all-encompassing training package on Prevention against Lightning (PaL) for Nepal and other APP countries where lightning is a major risk. The manual contains comprehensive information about basic protection mechanisms against lightning, causes of lightning and its impacts, and disaster risk management (DRM) related government policies and institutional mechanisms in Nepal. The document is an outcome of an extensive desk review of policies, strategies, guidelines, manuals, international standards, implementation-level documents prepared by the Government of Nepal, and related materials developed by consultants working on PaL in Nepal.

The goal of this training manual is to support DRM actors and those with a focus on PaL by enhancing their knowledge on DRM policies and institutional mechanisms related to PaL. This manual will provide stakeholders working in disaster management lessons about PaL that they can replicate in their respective organizations.

Contents

Preface	3
Acronyms	5
Introduction – Protection Against Lightning Training Manual	7
Module 0 Opening of the Training Workshop	12
Module 1 Introduction to DRM/R Related Policies and Institutional Mechanisms	15
SESSION 1.1 Disaster Risk Management Policy and Institutional Mechanisms in Nepal	16
SESSION 1.2 Adverse Effects of Lightning	24
SESSION 1.3 Role of Governmental and Non-governmental Organizations to Mitigate Lightning Hazards	26
SESSION 1.4 Importance of Mainstreaming DRM/R into Development in Nepal	28
Module 2 Technical Session	31
SESSION 2.1 Introduction to Fundamentals of Lightning	32
SESSION 2.2 Mechanism of Lightning Injuries/Damages and Personal Safety Measures	35
SESSION 2.3 Protection of Structures Against Lightning (External Protection)	38
SESSION 2.4 Conventional VS Non-Conventional Lightning Protection System	42
SESSION 2.5 An Introduction to Risk Assessment for the Installation of Appropriate LPS	45
Module 3 Technical Session (Internal Protection System)	48
SESSION 3.1 Internal Protection and Installation Concerns of Surge Protective Devices (SPDS)	49
SESSION 3.2 Effective Bonding and Grounding of Internal & External LPS	52
SESSION 3.3 Protecting Very Sensitive Public Buildings and Structures	55
Module 4 Field Assessment/ Hands on Training	58
SESSION 4.1 Outdoor activity - Measurement of earth resistance, estimating the LPS components, etc.	59
Annex	60
Annex II	62
Annex III	66
Annex IV: Sample Training Schedule	68

Acronyms

ADPC	Asian Disaster Preparedness Center
BCPR	Bureau for Crisis Prevention and Recovery
CCA	Climate Change Adaptation
CDO	Chief District Officer
DAS	Dissipative Array System
DDMC	District Disaster Management Committee
DEOC	District Emergency Operations Center
DM	Disaster Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EGM	Electro-Geometrical Model
EOC	Emergency Operations Center
ESE	Early Streamer Emission
GoN	Government of Nepal
HCT	Humanitarian Country Team
HFA	Hyogo Framework for Action
HRF	Humanitarian Response Facility
HVCA	Hazard, Vulnerability and Capacity Assessment
IASC	Inter-Agency Standing Committee
ICCM	Inter Cluster Coordination Meeting
ICRC	International Committee of the Red Cross
IEC	International Electrotechnical Commission
INGO	International Non-Government Organizations
IOM	International Organization for Migration
LEOC	Local Emergency Operation Center
LGOP	Local Government Operation Act
LPS	Lightning Protection System
LSGA	Local Self Governance Act

MHVRA	Multi Hazard Vulnerability Risk Assessment
MIRA	Multi Sector Initial Redid Assessment
MoHA	Ministry of Home Affairs
MoLMCPA	Ministry of Land Management, Cooperatives and Poverty Alleviation
NAST	Nepal Academy of Science and Technology, Government of Nepal
NCDM	National Council for Disaster Management
NCRA	National Calamity Relief Act
NDRRMA	National Disaster Risk Reduction and Management Authority
NEOC	National Emergency Operations Center
NGOs	Non-Government Organizations
NPC	National Planning Commission
PaL	Protection against Lightning
PDMC	Province Disaster Management Committee
PEOC	Province Emergency Operation Center
SLE	Semiconductor Lightning Eliminator
SPD	Surge Protective Device
UNDP	United Nations Development Programme

Introduction – Protection Against Lightning

Training Manual

Nepal, with its complex geo-topography, faces various natural disasters. Nepal has still been rebuilding the structures demolished by the 2015 massive earthquake that took lives of over 9,000 people. There are also additional disasters that Nepal faces yearly, such as floods, landslides, lightning, cold waves, etc. One of the natural hazards that kills over 100 people each year, but does not generate much public attention, is lightning. After the earthquake of 2015, lightning is the second major killer over the past 8 years when it comes to disasters. Lightning is also a major threat to livestock and communication equipment widely used throughout the country, especially the digital system. Realizing the seriousness of the threat of lightning in Nepal, ADPC took initiative to educate technicians, technocrats, civil society, policy makers, the private sector, the media, and people working in the humanitarian sector.

In 2017, ADPC conducted a baseline study with the objectives of understanding the risk of lightning hazards in Nepal; identifying the status of the public awareness and technical knowledge of safety measures and protection against lightning; and proposing a strategic roadmap for raising the level of awareness and strengthening the capacities for appropriate protective measures. The baseline study concluded that lightning hazards are a potential threat in Nepal that are largely ignored. Training programs on protection against lightning (PaL) were very rare. Although there have been several trainings and awareness raising programs on various disasters, lightning hazards were generally overlooked mainly due to lack of knowledge, expertise, and scattered casualties. It was concluded that there is a strong need for training programs on the personal safety measures and protection of structures. This training manual has been designed to train engineers and technicians on the basic principles of protection of structures and human against lightning hazards.

Goal of the Training

The overall aim of this training initiative is to support key stakeholders with developing the necessary skills to safeguard buildings, human lives, livestock, and physical property from lightning hazards.

Specific Objectives of the Training

The main objective of this training is to educate policy makers, academics, engineers, and technicians on the scientific techniques for protecting buildings, occupants and equipment from lightning hazards and ultimately to mitigate loss of lives and property due to lightning hazards.

At the end of the training, participants will be able to:

- Understand the basics of lightning and transients, lightning threats to humans and structures, lightning safety issues for humans and livestock, and the mechanism of lightning injuries.
- Identify the basic lightning safety measures to raise awareness in their society.
- Design lightning protection systems for various structures to safeguard the occupants.
- Compute risk assessments by applying the various parameters for designing appropriate protection systems.
- Describe the levels of threat and levels of protection needed according to the sensitivity of the structure and the occupants

Purpose and Scope

This training targets the general public, academic faculty members, policy/decision makers (such as members of Parliament), DRM/R professionals, and engineers focusing on:

- Fundamentals of lightning phenomena and personal safety measures
- Basic requirements of lightning protection
- International standards of lightning protection and practices
- Installation procedures of lightning protection components
- Risk assessment for appropriate level of protection.

Target Audience of Training

The training primarily targets engineers who are involved in building design and represent the monitoring institution. Module 1 of the training is targeted toward people such as:

- Local government
- Elected representatives of local bodies
- Engineers and technical persons engaged in development work both from government and private sectors
- Representatives from Local Humanitarian Organizations

- Policy/decision makers (e.g. members of Parliament)
- Faculty from academic institutions
- Journalists working with local and national media organizations

Summary of the Manual

The training manual is designed to respond to the needs of trainers who are conducting training courses on protection of structures against lightning hazards. The structure of the manual is as follows:

Module 0 - Contains the activities to formally open the training course. It includes the opening program, introduction of participants, expectations from the participants, discussion of the training design, course objective and program, schedule and other administrative arrangements.

Module 1 - Describes the Disaster Risk Management Policy and Institutional Mechanisms in Nepal, introduces the adverse effects of lightning and emphasizes on the potentiality of the threat. It also describes the role of governmental and non-governmental organizations for mitigating lightning hazards. Finally, it emphasizes the importance of DRR in Nepal.

Module 2 – Is the main technical module that introduces the fundamentals of the lightning covering the formation of clouds and electrical discharge in the cloud. It covers the mechanism of the injuries and damages caused by lightning. It also discusses about the scientifically acclaimed conventional lightning protection system and scientifically denounced non-conventional lightning protection system. This module further describes the methods to compute risk assessment for employing appropriate lightning protection system. This module mainly deals with the external protection system of building against lightning.

Module 3 - Deals with the internal protection system and the installation of Surge Protective Devices (SPD) for the protection of the equipment. It also discusses the effective bonding and grounding to avoid incidents. Finally, this module discusses effective ways to protect very sensitive public buildings.

Module 4 - Describes an outdoor activity to help participants gain a deeper understanding of protection techniques.

Teaching Methodologies

The following methodologies will be used for conducting the course:

- Interactive lectures and presentations
- Video/animation exhibition

- Group discussion/group discussion
- Outdoor activity for hands on training
- Table top exercise

Training Agenda

Following is the proposed agenda for the three-day course:

Date/Day	Topic/Activity	Methodologies
Day 1	<p>Module 0 Registration Pre-training test Inaugural session and group photo Course overview and introduction of participants</p> <p>Module 1 <i>Session 1:</i> Disaster Risk Management Policy and Institutional Mechanisms in Nepal <i>Session 2:</i> Adverse Effects of Lightning <i>Session 3:</i> Role of Governmental and Non-governmental Organizations to Mitigate Lightning Hazards <i>Session 4:</i> Importance of Mainstreaming DRM/R into Development in Nepal</p> <p>Module 2 <i>Session 1:</i> Introduction to Fundamentals of Lightning</p>	As per session introduction
Day 2	<p><i>Session 2:</i> Mechanism of Lightning Injuries/Damages and Personal Safety Measures <i>Session 3:</i> Protection of Structures against Lightning <i>Session 4:</i> Conventional Vs Non-conventional Lightning Protection Systems (LPS) <i>Session 5:</i> An Introduction to Risk Assessment for Appropriate LPS</p>	As per session introduction
Day 3	<p>Module 3 <i>Session 1:</i> Internal Protection and Installation Concerns of Surge Protective Devices (SPDs) <i>Session 2:</i> Effective Bonding and Grounding of Internal and External LPS <i>Session 3:</i> Protecting Very Sensitive Public Buildings and Structures</p> <p>Module 4 <i>Session 1:</i> Outdoor Activity, Measurement of Earth Resistance, Estimating LPS Components, etc.</p>	As per session introduction

Training Evaluation System

Following methodologies will be adopted for evaluation purposes:

Pre and Post Course Test

The idea of a “before and after” test is to find out what trainees know about the topic before training begins, and then to establish how much they learned from the training. While trainees may have differing levels of knowledge before the training about the topic or task to be addressed, the aim of the training is to bring them all to a similar level of knowledge or skill by the time the training ends. The questions in the pre-test and the post-test are identical. Pre-and post-test for this training can be found in Annex I. A test score compilation sheet is inserted as an object. Use this sheet to compile the test results.

Daily Feedback

At the end of each day, the management team will ask the participants to fill in a daily feedback form. Feedback given by the participants will be discussed in the debriefing meeting of the management team and trainers. The purpose of this feedback is to take corrective or preventive actions if required and make sure that mistake/errors in the previous day is not repeated in the next day. During the recap of the last day, the trainer will share the important actions taken as per the feedback given by the participants, while keeping confidentially and dignity principles in mind and practice. The daily feedback form is included in this manual.

Course Evaluation

Participants will be asked to fill out a course evaluation at the end of the training. The purpose of this evaluation is to generate responses from participants regarding their opinions about the training logistics and arrangements, classroom management, facilitator’s knowledge, skills and methodology used. Sample evaluation forms are attached in Annex II. The training coordinator will compile all the forms in the given excel sheet at the end of the evaluation. This will allow for an auto-analysis to be completed once data will be entered. The trainer will use these analyses in the training report.

Certificate Policy

Certificate of completion will be awarded to any participant if he/she:

- Has 95% attendance
- Has submitted all assignments given during the training period
- Cleared the post course test.

Sample Training Schedule

A sample of the training schedule has been prepared and available at Annex IV. This schedule can be changed based on the participants and targeted participants.

Module 0

Opening of the Training Workshop

Opening Activities

- Formally open the training
- Introduce the participations and facilitators to each other
- Discuss participant expectations
- Unite on the training objectives and program of activities
- Set technical arrangements such as schedule, formation of host team, house rules, etc.

Session at Glance

Timing	Topic	Method
25'	Activity 1: Participant introduction	Exercise
5'	Activity 2: Sharing of training objectives	Presentation
25'	Activity 3: Expectation check	Game
5'	Activity 4: Setting ground rules	Brainstorming

Duration



60'

Materials



- Name tags
- Opening program
- Training design and program of activities
- Easel paper
- Meta cards and colored paper
- Colored marking pens
- Different shapes of paper (heart, diamond, square etc.)
- Prizes for games (may be candies, chocolates, or office supplies)

Preparation



- Prepare 4 sheets of brown paper with content “Bus Stop” 1, 2, 3 & 4
- Prepare power point slides with title of training, training objectives, questions related to expectation check and ground rules

Process

Participant Introduction

- Participants draw self-portraits, write their names on the portraits, and explain their drawing to the group.
- For participants who do not know each other, you can play a game called “find the missing part.” First prepare different shapes out of paper (i.e., heart, circle, square, diamond, etc.), then cut the whole shape into 3 or 4 pieces, and distribute them to the participants. Next, instruct participants to look for their missing part. When they find all their missing parts in the shape, they will introduce themselves with the other parts of the shape. Then someone from the group will introduce other in the entire group in the training room.

Or

- Have participants make their own tags using colored papers or meta cards. Each participant will then explain why he/she choose the shape of color.

Sharing of Objectives

The training aims to enhance the participant’s skills, knowledge and increase confidence. At the end of the three-day training, participants will be able to:

- Describe the basic concepts of DRM/R.
- Discuss the government policy and mechanisms of DRM/R.
- Describe the DRM/R framework and its importance as a proactive approach.
- Discuss the humanitarian coordination architecture in the country and information management in emergency through the current architecture.

Expectation Check

- “Bus stop” prepare 4 sheets of brown paper for each of the following questions:
 - **Bus Stop 1:** What do you expect from the training?
 - **Bus Stop 2:** What can facilitate your learning and activate participation?
 - **Bus Stop 3:** What can hinder your learning and active participation?
 - **Bus Stop 4:** What can you contribute to the success of the training?
- Post the sheets of brown paper around the room as bus stop 1, 2, 3 and 4.

- Divide the participants into 4 groups. Ask participants to write their answer on the papers. Assign a sequence for discussion, as bus stop 1234, 2341, 3412, 4123.
- Discuss and summarize the expectations of the participants. Compare the expectations with the training objectives, contents, methods and schedule. Run through what expectations can be covered by the training and what is not within the scope of the training. Make a contract with the participants on the “Do’s” and “Don’ts” to facilitate sharing and learning.
- Make adjustments to the prepared training design necessary, based on results of the expectation check.
- Discuss answers and relate to the training design.
 - A ball of paper (or small ball or orange) is thrown to each participant in the circle who introduces him/herself and answers the same question as in BS 1. The facilitator takes notes of the expectations on the board. When all participants are finished, the facilitator discusses the answer and relates to the training design.
 - The participants add phrases to finish the sentence as follows:
 - I want to improve my knowledge, skills, attitude on -----.
 - I will contribute my ----- (knowledge, time, skills, attention, etc.).
 - I want my co-participants to be ----- to make this training fruitful and successful.
 - I will learn better and participate well in this training, if the facilitator will use the following methods and approaches -----.
- The answers can be put on meta-cards or presented by team and the facilitator collates the answer on the board then discusses the answer and relates it the training design.

Setting Ground Rules

Set ground rules for the training. Ask the participants and write their responses on the flip charts. Examples of ground rules could be punctuality, listening and sharing in the sessions, respecting each other’s and switching off mobile phones.

Module 1

Introduction to DRM/R Related Policies and Institutional Mechanisms

Sessions

Session 1.1

Disaster Risk Management Policy and Institutional Mechanisms in Nepal

Session 1.2

Adverse effects of Lightning (Lightning as a potential hazard)

Session 1.3

Role of Governmental and Non-governmental organizations to Mitigate Lightning Hazards

Session 1.4

Importance of Mainstreaming DRM/R into Development in Nepal

Disaster Risk Management Policy and Institutional Mechanisms in Nepal

Learning objectives:

After the end of this session, the participants are expected to:

- Explain key legal provisions and institutional frameworks related to Disaster Risk Management and Reduction (DRM/R) in Nepal;
- Relate applicable legal provisions related to DRM/R in Nepal; and
- Explain key roles and responsibilities of key institutions related to DRM/R in Nepal

Key messages:

- Disasters in Nepal were traditionally managed on an ad-hoc basis and focused on response.
- For the first time in 1982, the Natural Disaster Relief Act (NDRA), also known as the Natural Calamity Relief Act (NCRA), was enacted.
- In 2017, the Disaster Risk Reduction and Management Act, 2017, was put in place which adopts a holistic approach for disaster management.
- The National DRR policy and strategic action plans are developed in line with SFDRR (2018).
- The DRR & M Act (2017) has defined roles and responsibilities at all levels.
- The role of the private sector has also been recognized.
- The Act (2017) also envisages institutional reforms, which are yet to be materialized.

Session at Glance

Timing	Topic	Method
5'	Introduction	Lecture/Presentation
20'-30'	Legal and Institutional frameworks in Nepal	Presentation
10-15'	Question Answer	Discussion

Duration



30' - 45'

Materials



- PowerPoint Presentation
- Whiteboard/brown paper and markers

Preparation



- Prepare PowerPoint slides with session content
- Prepare for related questions from participants

Process:

Introduction

Explain the key objectives of the session as outlined in the learning objectives and explain what will be covered in the session.

This session is designed to provide basic information regarding the key institutional and legal provisions related to the DRM/R. Similarly, roles of different agencies and stakeholders according to the Nepal's DRM&R Act 2017 and other relevant legal and policy documents are introduced.

Presentation on Legal and Institutional Framework on DRR & M

Move through the presentation based on the existing legal and institutional provision, particularly the roles and responsibilities mandated by the Constitution, DRR & M Act (2017), National DRR policy and Strategic Action Plan (2018) and other legal/policy instruments. Similarly, discuss the structures at different levels and their mandates, such as the NDRR/M Council, Executive Committee, NDRR/M Authority, Provincial Disaster Management Committees, District Disaster Management Committee and Local (Municipal) Disaster Management Committees.

The presentation is recommended to be prepared in following sequence. While making the presentation, link and explain international frameworks and protocols such as SFDRR, SDGs Urban agenda and also discuss how they relate with the national legal and policy measures.

- **Constitutional and Legal provisions:** Present key legal and institutional provisions related to DRR/M in Nepal, in reference to the federal structure. For example, how the responsibilities under the DRR/M act is divided among the different levels of government – Federal, Provincial, District, and Local. Similarly, present a brief outline of other laws and policies such as the Local Government Act, National DRR/M rules, National DRR Action plans, periodic plans, etc.
- Discuss the roles and responsibilities of the Council, Executive committee, Provincial DM Committee, District DM committee and Local DM Committees.
- Introduce the roles and Responsibilities of NDRR/M Authority and the Chief Executive Officer, and highlight the coordination role of the authority.
- Explain the roles and responsibilities of the Emergency Operations Center, and highlight the roles of National, Province, District and Local Emergency Operation Centers (NEOC, PEOC, DEOC and LEOC) and their coordination/reporting structure.

You may add any additional structures and roles as seen important during the training program. The main strategy for this session is to engage the participants in discussion. Therefore, it is important that the participants share their experiences regarding the implementation of relevant legal and policy frameworks.

Synthesis and Session Closing

- Summarize the key legal/policy measures and also reflect on how it has been implemented at different levels based on the experiences shared by the participants and the experience of the facilitator.
- Ask participants how these legal/institutional provisions relate to their work.
- You may take notes if there are any concerns and suggestions presented by participants to further consideration by the relevant agencies.

Thank the participants and inform them about how you will be taking forward their important suggestions.

Handout 1: Brief on Institutional and Legal Provisions

Source: Nepal P., Khanal N., and Sharma B., 2018. Policies and institutions for disaster risk management in Nepal: A review. The Geographical Journal of Nepal. TU, Department of Geography.

Handout 1: Legal and Regulatory Frameworks¹

Governments establish laws and regulations, which provide the basis for promoting and enforcing certain rights and obligations to groups and individuals. In the context

¹ Source: Nepal P. ; Khanal N; and Sharma B, 2018. Policies and institutions for disaster risk management in Nepal: A review. The Geographical Journal of Nepal. TU, Department of Geography

of governance for DRM, laws set standards and objectives and assign mandates and responsibilities to different actors. Regulations and codes describe specific procedures and norms and seek to encourage or discourage certain behaviors. This rests upon the basic principle of “allowing or prohibiting activities” (Hughes, 1998) and creating incentives/ disincentives (e.g., taxes, penalties, tax breaks, subsidies, grants, etc.) that will either reward or punish. The effectiveness of legislation rests upon the administrative capacity of a country but also on the acceptance and awareness of rules and norms by the populace (UNDP/BCPR, 2007).

Disaster Risk Management Acts, Codes and Regulations

Disasters in Nepal were traditionally managed on an ad-hoc basis and attended to as and when they occurred. For the first time in 1982, the Natural Disaster Relief Act (NDRA) also known as the Natural Calamity Relief Act (NCRA), was enacted. The act was replaced by the recently endorsed Disaster Risk Reduction and Management Act, 2017.

The Soil and Watershed Conservation Act (1982) is one of the major DRM acts that has defined soil and water conservation as a function of controlling and saving landslides, floods, and soil erosion. The Water Resource Act (1992) focuses on minimizing the adverse effects on the environment by way of soil erosion, flood, landslide, or similar causes. The Forest Act, 1993 aims to design a comprehensive structure for preserving forest resources in Nepal from the perspective of disaster management. The Environment Protection Act, 1996 has made provisions for environmental impact assessments of activities before they are carried out. The Building Code (1998) has made provisions for the regulation of building construction in order to protect them against earthquakes, fires, and other natural calamities. Although, the Act has made local entities responsible, as the situation stands, integrated execution of concepts introduced through the Act have stalled due to the absence of necessary rules, budgetary allocation, and adequate guidance (MoHA, 2009; Pradhan, 2007). The Prime Minister Relief Fund Regulation (2007) has made provisions for funding rescue, assistance, medical treatment, aid to poor people, and aid for charity projects. The Constitution of Nepal (2015) has spelled out disaster management in its Directive Principles, Policies and Obligations of the State (Clause 51) regarding advance warning, preparedness, rescue, relief and rehabilitation in order to mitigate risks from natural disasters. The constitution has given the clear mandate to central and local levels government to work on preparedness, rescue, relief and rehabilitation from natural and human-made calamities for disaster management under the Schedule/ section -7, 8 and 9 (Constitutional Assembly Secretariat, 2015). The Local Government Operation Act (LGOA) 2017, which has replaced Local Self Governance Act (LSGA) 1999, empowers local bodies to govern themselves. It recognizes that local people and local bodies are the most appropriate points of entry to meet the disaster management needs at the community level. The LGOA authorizes local bodies to undertake following functions with respect to DRR (MoLMCPA, 2017):

- Develop local level policies, legislation, standards, plan implementation, monitoring and evaluation related to disaster management;
- Disaster preparedness and response planning, early warning systems, search and rescue, advance store of relief materials, distribution and coordination at the local level;

- Local embankment, river and landslide control, river management and evaluation;
- Hazard mapping and identification of settlements at risk and transformation;
- Coordination between federal, state and local levels and local community organizations and coordination with the private sector in order to improve disaster management;
- Establishment of disaster management fund and operation and utilization of resources;
- Resettlement and rehabilitation after disaster(s);
- Data management and research about local level disaster(s);
- Development of local emergency operation system; and
- Implementation of community-based disaster management.

This Act is currently promulgated and has made several provisions to undertake activities on disaster risk reduction at the local level. However, the capacity of the local government is very weak to effectively design, implement and monitor the disaster risk management activities.

The currently endorsed Disaster Risk Reduction and Management Act, 2017 has made provisions for effective disaster risk management throughout the disaster management cycle-preparedness, response and rehabilitation and mitigation (MoLMCPA, 2017). This Act replaces the Natural Calamity Relief Act of 1982. The significant features of the Act are:

- The Natural Calamity Relief Act, 1982 did not cover the broader spectrum of hazard mitigation and disaster risk management and categorization of the diverse disasters of Nepal, which each require unique attention. Against this backdrop, this new Disaster Management Act has incorporated the full disaster management cycle for a diverse array of disasters;
- Disasters are defined distinctly as natural and human induced;
- This Act provides a detailed action plan from the central government to the district and local levels to execute a disaster management plan. According to the act, the National Council for Disaster Management (NCDM) will function under the chairmanship of the prime minister. The National Disaster Risk Reduction and Management Authority (NDRRMA) under the NCDM will be established under the Ministry to act as the focal point for disaster management functions in Nepal. This ranges from the formulation of appropriate strategies to plans to implement and supervise disaster management activities. Similarly, the state disaster management authorities will fall under the Chief Ministers and the district disaster management authorities under the Chief District Officers (CDOs);

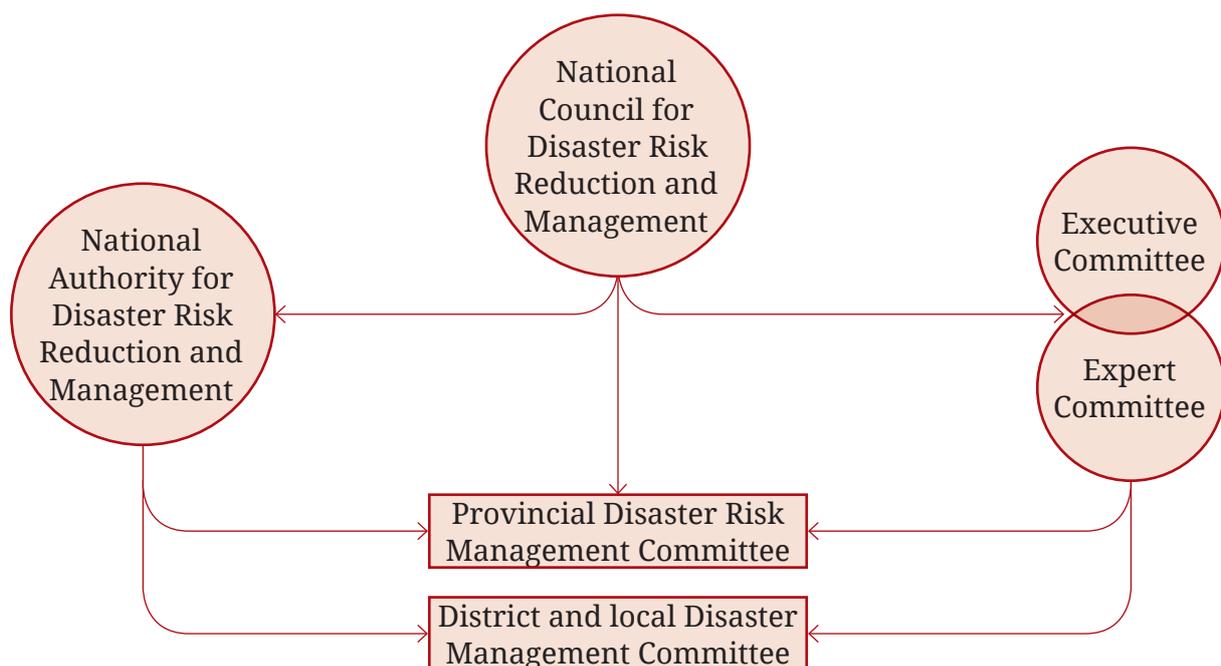
- The role, responsibilities and functions of security forces, including the Nepal Army, are clarified;
- This Act has made provisions for recommendations to the Government of Nepal for the declaration of disaster-prone zones, streamlining of responsibilities, and involvement of local communities.

Institutional/Organizational Structure for Disaster Risk

Management

By replacing the institutional structure of the Natural Disaster Relief Act (NDRA), 1982 and modifying the institutional structure for disaster risk management proposed by National Strategy for Disaster Management, 2009, the currently endorsed Disaster Risk Reduction and Management Act, 2017 has made provisions of new institutional set-up for disaster risk management (MoLMCPA, 2017) and is displayed in Figure 1:

Figure 1. **Institutional structure according to the Disaster Risk Reduction and Management Act - 2017.**



The Disaster Risk Reduction and Management Act, 2017 has made provisions for the establishment of the National Council for Disaster Risk Reduction and Management (NCDRRM) under the chairmanship of the Prime Minister as an apex body in order to support disaster risk reduction and management. In order to implement policies and plans formulated by the council, there will be an executive committee under the Home Minister, as well as an expert team not exceeding five numbers from different thematic areas such as geology, environment, infrastructure, among others. The National Disaster Reduction and Management Authority (NDRMA) will be set-up under the Home Ministry. At the Provincial level, the Province Disaster Management Committee (PDMC) under

the chairmanship of chief minister will be established. At the local level, there will be a District Disaster Management Committee (DDMC) and Local Disaster Management Committee (LDMC). The major rights, responsibilities and duties provisioned by this Act are given in Table 3 and institutional set-up by disaster types, level of governance and disaster management cycles is outlined in Table 1.

Table 1. **Institutional provisions for disaster risk management**

Institutions by Level		Functions
National/ Federal Level	National Council for Disaster Risk Reduction and Management (NCDRRM)	<ul style="list-style-type: none"> • Approve national disaster management policies and plans • Provide direction to executive committee and national authorities • Provide policy guidance to province and local levels • Manage financial resources for disaster management • Evaluate of disaster management activities
	Executive Committee	<ul style="list-style-type: none"> • Submit the national policies and plans to the council • Implement disaster risk reduction, disaster response and rehabilitation and mitigation related policies and programs depending upon the limits of approved policies and plans by the council • Implement and approve the disaster risk reduction strategies and programs • Determine the role of public, private and non-government organizations (NGOs) on disaster management • Determine the role and responsibilities of the concerned ministries, departments and other institutions regarding disaster management. • Conduct institutional capacity building for national, provincial, district and local levels on disaster management. • Incorporate disaster management related courses from the school level to higher education. • Conduct vulnerability assessment and hazard mapping
	National Disaster Reduction and Management Authority (NDRMA)	<ul style="list-style-type: none"> • Implement the plans, programs and decisions approved from the council and executive committee • Serve as a resource center for disaster reduction and management • Study and conduct research in the issues about causes and mitigation measures of landslides, floods, earthquakes, climate change, land-use changes, and other hazards and disasters. • Provide financial and technical assistance to provinces and local level sto prepare periodic plans related to disaster management. • Involve private, NGOs, and local communities in disaster management • Form search and rescue teams for national, provincial and local levels, and build their capacities for responding to disasters • Mobilize security forces and search and rescue teams. • Create awareness about disaster management

Province/ State Level	Province Disaster Management Committee (PDMC)	<ul style="list-style-type: none"> • Implement disaster-related medium-term and short-term policies, plans and programs at the province level based on the approved national policies and plans from the council. Facilitation and coordination for effectiveness of the preparedness activities of the local disaster management committee • Coordinate with national, provincial and local levels to ensure • effective search and rescue efforts are in place • Create standards for rescue items management • Manage drinking water, food, clothes and medicines in disaster affected areas • Recommend GoN to declare emergency in disaster affected areas • Move people to safe places • Establish disaster management information system and installation of Early Warning System (EWS)
Local Level	District Disaster Management Committee (DDMC)	<ul style="list-style-type: none"> • Implement policies, plans and programs approved by council, executive committee and province committees • Prepare and implement Disaster Response Plan of the district • Mobilize emergency operation center (EOC) in the district • Conduct search and rescue works in the affected areas • Manage dead bodies due to disasters • Manage drinking water, food, clothes and medicines in disaster affected areas • Ensure security forces are in place • Coordinate national and international assistance during disaster and regular information flow among the stakeholders.
	Local Disaster Management Committee (LDMC).	<ul style="list-style-type: none"> • Design and implement local disaster management plan • Allocate budget for disaster reduction • Coordinate public, private, NGOs, local volunteers and social mobilizers to conduct disaster management activities • Implement building codes and standards/guidelines • Form disaster preparedness committee at ward and community levels • Conduct training about mock-drills • Manage rescue and relief at affected areas • Establish disaster management information system and installation of Early Warning System (EWS) • Activate the emergency operation center (EOC) at local level

Adverse Effects of Lightning

Learning Objectives:

At the end of the session, participants will be able to:

- Describe the magnitude of threats and losses due to lightning hazards
- Recognize the nature of lightning injuries and damage to physical structures
- Recognize Nepal's position and severity of the threat in the perspective of lightning hazards
- Identify lightning prone regions in Nepal
- Understand and realize the potential of the lightning as a natural hazard
- Realize the threats of lightning to humans, livestock, electrical and appliances, forests, and physical structures.

Key Messages:

- Prevailing myths about lightning in society
- Lightning myths in the global perspective
- Lightning prone areas of Nepal
- Lightning as a potential threat to the public, livestock, structures and modern electronic appliances

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Introduction – Myths and superstitions about lightning	Ask the participants about their perceptions of lightning
20'	Activity 2: Myths of lightning in various human civilizations	Presentation of pictures on the myths of lightning from various human civilizations
20'	Activity 3: Damages and fatalities due to lightning	Presentation of lightning map, demography of fatalities
5'	Synthesis and session evaluation	Question and answer

Duration



60'

Materials



- Photographs/pictures
- Different color marking pens
- Power point presentation/slides
- Video/music

Preparation



- Prepare power point of session objectives, including video that represents the prevailing myths in the society
- Prepare slides incorporating the photographs representing lightning myths from various civilizations/cultures

Process:

Activity 1: Introduction – Myths and superstitions about lightning / 15'

Explain the learning objectives and the outline of your session and the specific lessons they are expected to achieve from the session. At the start of the session, ask the participants about their understanding of the word “lightning”.

- Ask them the local name for lightning (five participants).
- Ask five participants to explain their experiences about lightning related incidents, such as fatalities, injuries, etc.

Activity 2: Myths about lightning in various human civilizations / 20'

- Displays photographs about the myths of lightning from various parts of the world. For example, Thor with hammer in Scandinavian countries, Indra with Bajra in Hinduism, Buddha with Bajra or Dorje in Buddhism, Magical thunderbird in North American mythology, etc.

Activity 3: Damages and fatalities due to lightning / 20'

- Display photographs or depiction of lightning fatalities, occurrence map, damaged appliances and buildings, and trees struck by lightning
- Show clippings from various news reports that cover multiple casualties
- Display the global lightning map and a lightning map for Nepal

Synthesis and Session Evaluation / 5'

- Ask the participants if they have questions or clarifications about the topics discussed. Encourage the participants to share their stories and experiences, particularly if they have become victims Thank the participants and inform them of the next session.

Role of Governmental and Non-governmental Organizations to Mitigate Lightning Hazards

Learning Objectives:

At the end of the session, participants will be able to:

- Understand and realize the potentiality of the lightning as a natural hazard
- Realize the threats of lightning to humans, livestock, electronic appliances, forests, and physical structures

Key Messages:

- The overview will serve as the eye-opening session to garner interest
- The overview will increase awareness among the participants that lightning is a serious threat to the developing world, and a bigger challenge to the advancement of technology

Session at a Glance

Timing	Topic	Method
20'	Activity 1: Introduction – Overview of lightning fatalities in Nepal and the world	Presentation
15'	Activity 2: Presentation of the fatalities map and lightning occurrence map	Presentation
5'	Synthesis and session evaluation	Question and answer

Duration



40'

Materials



- Easel board and papers.
- Different color marking pens
- Charts
- Power point presentation/slides
- Video clips of lightning incidents and strikes

Preparation



- Obtain the lightning fatalities map, using the data from National Emergency Operation Center (NEOC)
- Obtain the lightning strike map of Nepal, and that of the world using the data from Department of meteorology and hydrology or similar institutes

Process:

Activity 1: Introduction / 20'

Explain the learning objectives and the outline of your session with the specific lessons they expected to achieve by the end of the session. At the end of the session, participants will be able to:

- Identify the lightning prone regions in Nepal.
- Identify the position of Nepal in the perspective of lightning occurrence in the globe.

Activity 2: Presentation of the fatalities map, and lightning occurrence map / 15'

- Ask the participants to guess the number fatalities and loss of livestock and about the most lightning prone district of Nepal
- Ask the participants to share their experiences about property damage by lightning
- Display the photographs of lightning hazards through slides
- Show a bar diagram of annual fatalities
- Display the fatality map of Nepal

Synthesis and Session Evaluation / 5' & 5'

- Ask the participants if they have questions or clarifications about the topics discussed.
- Answer their questions and provide examples as necessary.
- If there are no more questions, ask the participants if the discussions on the topic met their standards.
- Thank the participants and inform them of the next session.

Handout

- Handout 5: Statistics of lightning incidents and damages along with fatality map

Importance of Mainstreaming DRM/R into Development in Nepal

Learning objectives:

After the end of this session, the participants are expected to:

- Explain the importance of mainstreaming DRM into development; and
- List examples and ideas for mainstreaming DRR into development process related to their job.

Key Message:

- Sustainable Development has three pillars: Economic, social and environmental.
- Disaster and development are interrelated.
- Disaster hampers development and sometimes also provides opportunities to develop.
- Development can both increase and decrease disaster risks.
- Disaster and poverty have a strong link. Disasters can cause a vicious cycle of poverty, while at the same time, provide opportunities to build back better.
- Mainstreaming DRR and CCA into development can help with sustainable development

Session at Glance

Timing	Topic	Method
5'	Introduction	Lecture/Presentation
20-30'	Mainstream DRM into development	Presentation
5-10'	Synthesis and Question Answer	Discussion

Duration

**30' - 45'**

Materials



- PowerPoint Presentation
- Whiteboard/brown paper and markers

Preparation



- Prepare PowerPoint slides with session content
- Prepare for related questions from participants

Process:

Introduction

This session aims to sensitize and provide insight regarding the importance and processes of mainstreaming DRM into development planning.

You may start with a short video or some photographs showing examples of increasing disaster risks due to improper consideration of disaster risks during the development process (e.g., landside hazard in Nepal due to haphazard road construction, increase and urban flooding due to improper draining system).

Ask questions, such as whether any similar practices/examples are present in the participant's work area, and encourage participants to share experiences regarding how and why this has happened.

Presentation and Discussion on Mainstreaming DRM into Development

Include examples of successes and failures of mainstreaming DRM into development. Present specific examples of both sides (good and bad practices) and also discuss why and how disaster risk management should be mainstreamed into the development process.

Some suggested areas to include in the presentation are:

- Overall situation of disaster (Nepal context): The facilitator may present data regarding natural disasters (available from the DRR Portal) and create a summary of key disasters, such as earthquakes, floods, epidemics, lightning, etc.
- Concept of Sustainable Development with reference to SDGs/other: Present key criteria for sustainable development with reference to national/international frameworks.

- Highlight the components and interrelationship of the sustainable development triangle – Economic, Social and Environmental.
- Interrelationship between development and disaster: Highlight how the disaster can stop or affect development and also how a disaster may also present opportunities for development. Similarly, discuss the effects of disasters for people residing underdeveloped or developed countries/areas.
- Concept of DM Mainstreaming: Describe the evolution of development planning and how DM can be mainstreamed.
- Provide examples of DM mainstreaming (both at national and international levels): Present examples of effects, when disaster is mainstreamed or not mainstreamed into the development planning and implementation process.

Synthesis and Session Closing

Summarize key takeaways and provide opportunities for participants to share their reflections.

Module 2

Technical Session (Structural Protection/External Protection)

SESSIONS

Session 2.1

Introduction to the Fundamentals of Lightning

Session 2.2

Mechanism of Lightning Injuries/Damages and Personal Safety Measures

Session 2.3

Protection of Structures against Lightning (External Protection)

Session 2.4

Conventional against Non-conventional Lightning Protection System (LPS)

Session 2.5

An Introduction to Risk Assessment for Appropriate LPS

Introduction To Fundamentals of Lightning

Learning objectives:

At the end of the session, participants will be able to:

- Explain the science behind lightning phenomena.
- Explain the types and nature of lightning activities.
- Understand that lightning is nothing but an electrical discharge.
- Understand the cause of physical damage.
- Understand the potential of lightning hazards.
- Understand the extent of lightning threats in Nepal.

Key Messages:

- Mechanism of a thunder cloud formation
- Mechanism of charge formation in the clouds
- Initiation of lightning discharge within the cloud
- Lightning is a large electrical discharge carrying an enormous amount of current
- Cause and magnitude of electric current associated with lightning channel
- Cause of heat and thunder during the lightning flash

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Introduction – How does a cloud form?	Brainstorming and presentation
20'	Activity 2: Mechanism of charge formation	Presentation
25'	Activity 3: Mechanism of electrical discharge within the clouds	Presentation

25'	Activity 4: Flow of current and creating heat, light and thunder	Presentation
5'	Synthesis and session evaluation	Question and answer

Duration



90'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - How is a cloud formed?
 - What causes electrical discharge?
 - Mechanism of charge formation
 - Mechanism of production of heat and thunder
- Provide handout for each participant

Process:

Activity 1: Introduction – How does a cloud form? / 15'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain the mechanism of formation of the thunder cloud
- Explain the process of heating of earth surface by sun's heat resulting in the thunder cloud

Ask the participants about their understanding of the mechanism of cloud formation.

Conclude the discussion using power point slides/ animations on the mechanism of cloud formation.

Activity 2: Mechanism of charge formation in the cloud / 20'

Ask some participants about the cause of cloud electrification. Explain the basic concept of charge formation by friction. Explain the process of conversion of water vapor into snowflakes and their movement within the cloud. Furthermore, explain the temperature profile of the cloud where charge formation takes place. Show the animations for the better understanding of the participants.

Activity 3: Mechanism of electrical discharge within the cloud / 25'

Show videos/animations on the electrical discharge within the cloud. Explain accumulation of charge over two regions of the clouds and electrification of earth's surface by induction. Explain the minimum value of electric potential difference needed to break the insulation of the atmospheric air. Make the analogy of sparks observed in woolen cloths during winter evenings with that of discharge within the cloud and between the cloud and the ground.

Activity 4: Flow of current and creating heat, light, and thunder / 25'

Show the videos/animation to support participant understanding about the mechanism of the flow of electric charge from one region to the other. Explain what makes the current associated with lightning so high. Make a comparison with the domestic electrical power supply. Make an analogy between the heating effect of current and production of light due to electrical current. Ask the participants about the sound production due to heat. Make an analogy between the spluttering when one sprinkles water into hot oil. Explain the scale of sound produced by the lightning channel of which the temperature rises to about 30,000 Degrees Celsius.

Synthesis and Session Evaluation / 5'

- Ask the participants if they have questions or clarifications about the topics discussed.
- Answer their questions and provide examples as necessary.
- If there are no more questions, ask the participants if the discussions on the topic met their standards. Ask them few questions to validate their learning. Randomly choose the people who will answer the questions.
 - What is a cloud?
 - What causes cloud electrification?
 - What is the cause of heat and thunder?
- Thank the participants and inform them of the next session.

Handouts

Provide the handouts on the fundamentals of lightning to each participant.

SESSION 2.2

Mechanism of Lightning Injuries/Damages and Personal Safety Measures

Learning objectives:

At the end of the session, participants will be able to:

- Explain the cause of lightning hazards
- Distinguish between direct and indirect effects of lightning
- Explain the cause of injuries and damage
- Identify safe shelters and unsafe shelters
- List basic personal safety precaution measures
- Recognize the period of potential threat of lightning
- Describe safety measures while outdoors and indoors

Key Messages:

- Mechanism of lightning injuries
- Risky places regarding lightning strikes
- Safe and unsafe shelters
- Personal safety measures while outdoors and indoors

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Introduction – What causes lightning damage and injuries?	Brainstorming and presentation
20'	Activity 2: Possible ways to get injured	Presentation/ Animation
15'	Activity 3: Safety Measures while outdoors and indoors	Presentation
10'	Synthesis and session evaluation	Question and answer

Duration



60'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for session objectives
 - Mechanism of flow of current
 - Mechanism of attachment of the current to the objects
 - Show the taller object are more vulnerable
 - Show safe shelters and unsafe shelters
 - Show dos and don'ts during thunderstorms
- Provide handouts for each participant

Process:

Activity 1: Introduction – What causes lightning damage and injuries? / 15'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain the mechanism of injuries and damage due to lightning discharge
- Explain the possibilities of getting struck or injured

Ask participants which of these monkeys is more prone to lightning strikes (1) a monkey standing on its two legs or (2) a monkey walking on its four legs

Conclude the discussion using power point slides/animations on the mechanism of cloud formation.

Activity 2: Mechanism of charge formation in the cloud / 20'

Ask some participants what the cause of cloud electrification is. Explain the basic concept of charge formation by friction. Explain the process of conversion of water vapor into snowflakes and their movement within the cloud. Furthermore, explain the temperature profile of the cloud where charge formation take place. Show the animations for the better understanding of the participants

Activity 3: Possible ways to get injured / 15'

Show videos/animation of the mechanism of flow of current. Explain the term of step potential and show that the larger the separation of legs, the higher the magnitude of current that flows through the body. Make an analogy about the potential difference

with the increase in height of a waterfall. Explain why an electric current jumps from tree to a human standing under a tree. Explain the process of surface arcing and the possibility of getting injured sheltering in a cave.

Synthesis and Session Evaluation / 10'

- Ask the participants why the number of fatalities of livestock is more than that of humans in terms of step potential.
- Ask the participants if they have any further queries on the mechanism and safe shelters and clarify if necessary.
- If there are no more questions, thank the participants and inform them of the next session.

Handouts

Provide the handouts on the mechanism of lightning injuries and list of dos and don'ts for public awareness.

Protection of Structures Against Lightning (External Protection)

Learning objectives:

At the end of the session, participants will be able to:

- Explain the basic principles on protection of structure against lightning.
- Differentiate between the earthing of electrical supply and earthing of lightning protection.
- Explain the various components of lightning protection and their role.
- Explain the level of lightning protection.
- Explain the different methods of installation of air terminals.
- Calculate the distance between air terminals based on Electro-Geometrical Model (EGM).
- Determine the separation of down conductors based on the level of protection.
- Explain the various types of earthing and techniques for improving earth resistance.
- Describe the meaning and significance of equipotential bonding.
- Describe the function of surge protective devices and their role in protecting equipment inside a building.

Key Messages:

- Scientific techniques of external lightning protection
- International standards of lightning protection
- Levels/class of lightning protection
- Methods of positioning air terminals (Protective angle, rolling sphere and mesh) and most scientific method

- Positioning down conductors
- Effective earthing technique

Session at a Glance

Timing	Topic	Method
10'	Activity 1: Demonstrate the basic principle of external lightning protection	Video (animation) exhibition on external protection
10'	Activity 2: Basic principle of external protection	Presentation /Slides
15'	Activity 3: Four levels of external LPS (in accordance with standards)	Presentation
20'	Activity 4: Methods of positioning air terminals (as per the level of protection)	Presentation
15'	Activity 5: Down conductors' system	Presentation
15'	Activity 6: Effective grounding/earthing techniques	Presentation/animation
15'	Synthesis and session evaluation	Question and answer

Duration



100'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - Mechanism attachment of current to the structures/objects
 - Computation of the separation of the air terminals in reference to the striking distance (final jump of the attachment)
 - Show that electro geometrical method is more scientific method for complex structures
 - Effective method of positioning down conductor
 - Effective techniques of earthing or grounding in reference to the ground resistance
- Provide handout on the topic to each participant. The handout should include the list of the dimensions of all the components of LPS corresponding to the type of conductor used. Provide the tables and formula for the computation of the separation of the air terminals corresponding to each level of protection.

Process:

Activity 1: Demonstration of the basic principle of external lightning protection / 10'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain fundamentals of building protection

Activity 2: Basic principles of external protection / 10'

Explain the basic principles of building protection considering the magnitude of current that flows in the lightning current. Explain why some conductors are preferred over the others as LPS components.

Activity 3: Four levels of external LPS (in accordance with International Standards) / 15'

Discuss the various types of international standards for lightning protection in practice. Explain the most scientific international standard called International Electrotechnical Commission (IEC) standard. Explain the four levels of protection and their efficiencies in terms of minimum and maximum current.

Activity 4: Methods of positioning air terminals (as per the level of protection) / 20'

Explain three methods of installing air terminals, namely the protective angle method, rolling sphere method and mesh method. Show the computation that explains the relationship between the magnitude of current and striking distance. Show the graph that provides an account of the installing the air terminals with the height and angle of protection. Discuss about the rolling sphere method and show the relationship between the magnitude of current and radius of the sphere. Present a table that shows the separation of the air terminals depending upon their heights and level of protection. Furthermore, provide the formula to compute the separation distance as per rolling sphere method. Discuss the mesh method. Explain why the rolling sphere method is more effective than others in any shaped structure. Finally, give a brief account of the dimensions and shape of the air terminals.

Activity 5: Down conductor system / 15'

Explain the principle of down conductor system. Present the dimensions of the down conductor system and their separation as per the level of protection. Explain how to lay the down conductor on the wall, on the roof, along the truss and metallic sheets. Explain why the down conductors should not be bent by more than 45 degrees. Provide a table for an account of the dimensions of the down conductor for corresponding metals.

Activity 6: Effective grounding/earthing techniques / 15'

Explain that earth termination system plays an equally important role as that of air terminals. Explain the types of earthing and backfill material for effective grounding. Give an account of the dimensions of the earth electrode and possible shapes. Explain why some of the metals are preferred over others for effective earthing.

Synthesis and Session Evaluation / 15'

- Ask some participants to recapitulate the protection system.
- Ask the participants about the parameters to be taken into account for the protection system.
- Ask the participant what needs to be considered for the minimum and maximum current to decide for the level of protection.
- Ask the participants for any further clarification and clarify where necessary. If there are no more questions, thank the participants and inform them of the next session.

Handouts

Provide the handouts on the external protection system along with all the tables of dimensions of components, the table for the positioning of the air terminals, and down conductors.

Conventional vs Non-Conventional Lightning Protection System

Learning objectives:

At the end of the session, participants will be able to:

- Differentiate between conventional and non-conventional lightning arrestors and corresponding protection systems
- Describe the working principles of non-conventional lightning arrestors
- Explain the position of non-conventional air terminals in the building/electrical codes of various countries
- Explain the non-superiority of the non-conventional over conventional ones
- Denounce fraudulence claims by some vendors
- Recommend the most cost effective and appropriate air terminal system

Key Messages:

- Difference between conventional and non-conventional air terminals
- Working principle of non-conventional arrestors
- Non superiority of non-conventional LPS
- Fraudulent claims of some vendors

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Demonstrate various types of air terminals	Presentation/ photographs
20'	Activity 2: Working principle of various air terminals (arrestors)	Presentation /Slides
15'	Activity 3: Failures of the non-conventional arrestors	Presentation/ photographs

10' Synthesis and session evaluation

Question and answer

Duration



60'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - Various types of conventional and non-conventional air terminals
 - Working principles of various types of air terminals
 - Non superiority of non-conventional air terminals over conventional ones.
- Provide handout on the topic to each participant. The handout should include the various types of air terminals along with their photographs. Also provide the evidences/basis of failures of the non-conventional air terminals.

Process:

Activity 1: Demonstrate various types of air terminals / 15'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Identify the various types of the air terminals

Activity 2: Working principles of various air terminals (arrestors) / 20'

Explain the working principles of various types of air terminals such as Early Streamer Emission (ESE), Dissipative Array System (DAS), Semiconductor Lightning Eliminator (SLE), etc.

Activity 3: Failures of the non-conventional arrestors / 15'

Show the photographic evidences of the failures of non-conventional air terminal systems against their claims. Also show the video/photographic evidence for showing the non-superiority of the non-conventional arrestors over that of conventional ones. Explain why the claimed superiority of the non-conventional arrestors can be denounced theoretically.

Synthesis and Session Evaluation / 10'

- Ask some participants to state the types of air terminals.

- Ask a participant about the working principle of one of the arrestors.
- Ask the participants for any further clarification and clarify where necessary. If there are no more questions, thank the participants and inform them of the next session.

Handouts

Provide the handouts on the external protection system along with all the tables of dimensions of components, table for the positioning of the air terminals, and down conductors.

SESSION 2.5

An Introduction to Risk Assessment for the Installation of Appropriate LPS

Learning objectives:

At the end of the session, participants will be able to:

- Estimate the potentiality of lightning threat
- Explain the need for risk assessment
- Explain the various parameters determining the threat to a structure
- Identify the level of protection needed on a given structure based on risk assessment
- Recommend the level of lightning protection at given location and in accordance with the sensitivity of a structure

Key Messages:

- Lightning density and potential threat of location
- Assessing the risk of a location and a building
- Sensitive buildings/structures

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Demonstrate lightning map of Nepal	Presentation/ photographs
20'	Activity 2: Potentiality of lightning threat at a given location	Presentation/slides
25'	Activity 3: Sensitivity of a building and appropriate LPS	Presentation/ computation
10'	Synthesis and session evaluation	Question and answer

Duration



70'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Calculator
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - Threat of lightning hazard to a given structure
 - Sensitivity of a building or structure
 - Recommendation of appropriate LPS on a given structure
- Provide handout on the topic to each participant. The handout should include the lightning density map of Nepal, and various parameters that determine the level of threat on a building. Also provide the formula for the computation of the level of risk using various parameters.

Process:

Activity 1: Demonstrate lightning map of Nepal / 15'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Identify the density of lightning strikes over the locations under consideration
- Identify the lightning prone regions of Nepal

Activity 2: Potentiality of lightning threat at a given location / 20'

Explain that the potentiality of the lightning threat depends upon the density of the lightning strikes, elevation of the location, environment of the structure under consideration, type of construction material used in the building, size of the building, etc.

Activity 3: Sensitivity of a building and appropriate LPS / 25'

Consider the various types of buildings to distinguish the sensitivity based on the number of occupants, nature of occupants, equipment installed, nature of material kept, etc. For example, consider a gas storage tank, a school building, a hospital and a warehouse and compare their sensitivities. Explain the source of damages and types of losses in the perspective lightning hazards. Provide a formula to compute the level of risk based on the various factors. Engage the participants for the computation of the level of risk on a structure at certain location (an example) and ask them to recommend a level of protection.

Synthesis and Session Evaluation / 10'

- Ask participants about the need for a risk assessment.
- Ask a participant to recommend the level protection on an industrial building.
- Ask the participants for any further clarification and clarify where necessary. If there are no more questions, thank the participants and inform them of the next session.

Handouts

Provide handouts on risk assessment that includes the computational formula for recommending the level of protection.

Module 3

Technical Session (Internal Protection System)

SESSIONS

Session 3.1

Internal Protection System and Installations Concerns of Surge Protective Devices (SPDs)

Session 3.2

Effective Bonding and Grounding of Internal and External LPS

Session 3.3

Protecting Very Sensitive Public Buildings and Structures

SESSION 3.1

Internal Protection and Installation Concerns of Surge Protective Devices (SPDS)

Learning objectives:

At the end of the session, participants will be able to:

- Explain the transient nature of lightning impulses
- Explain the nature of surges and their impacts on the electrical and electronic appliances
- Explain the role of (Surge Protective Devices) SPDs for the internal protection
- Explain the working principle of SPDs
- Explain the zones of internal protection
- Explain the class of SPDs
- Make appropriate selection of SPDs for a zone under consideration

Key Messages:

- Importance of internal protection system
- Lightning surges
- Surge protective devices and their applications
- Zonal concept of internal protection
- Types of surge protective devices

Session at a Glance

Timing	Topic	Method
15'	Activity 1: Introduction – Internal Protection System	Brainstorming and presentation
15'	Activity 2: Lightning and other surges and their impacts on appliances	Presentation

20'	Activity 3: Surge Protective Devices and their class	Presentation
15'	Activity 4: Installations of appropriate SPDs at various zones	Presentation
10'	Synthesis and session evaluation	Question and answer

Duration



75'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
- What is a surge?
- What causes damage to the electronic appliances kept inside a building?
- How does a surge protective device work?
- Class of SPD and protection zones
- Provide handouts describing the types of surges, class of surge protective devices, and their installation concerns, and zonal concept of internal protection to all participants.

Process:

Activity 1: Introduction – Internal Protection System / 15'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain internal protection
- Explain the function of SPDs and their use in the internal protection system
- Explain the zonal concept of internal protection

Ask the participants about the need for the internal protection system. Ask about their experiences with damages from electrical or electronic equipment due to indirect lightning or lightning surges.

Show the video exhibition on lightning surges and their impacts on electrical and electronic appliances. Explain the need for internal protection with an emphasis that internal protection system as important as external protection for the protection of electrical and electronic appliances, short circuiting, tripping, etc.

Activity 2: Lightning and other surges and their impacts on appliances / 15'

Ask the participants about the meaning of a surge and provide examples of the sources of surges. Answer questions and clarify the meaning of surges. Explain how electrical surges damage electrical and electronic appliances. Explain the types of lightning surges in terms of their impulse parameter with the help of time-current graphs.

Activity 3: Surge Protective Devices and their class / 20'

Explain the working principle of a surge protective device. Explain how the SPDs are classified. Explain the response time of each class of SPD.

Activity 4: Installations of appropriate SPDs at various zones / 15'

Explain the zonal concept of a building for the installation appropriate SPD. Discuss the role of each SPD at a given zone of protection. Show the method of installing the SPD.

Synthesis and Session Evaluation / 10'

- Ask the participants about the internal protection system
- Ask the participants about role of SPD in the protection of equipment
- Ask the participants if they have any questions that require clarification and answer their queries if needed.

If there are no more questions, ask the participants if the discussions on the topic met their standards.

- Thank the participants and inform them of the next session.

Handouts

Provide the handouts on the internal protection system to each participant incorporating the function of SPDs.

Effective Bonding and Grounding of Internal & External LPS

Learning objectives:

At the end of the session, participants will be able to:

- Explain equipotential bonding
- Explain the importance of equipotential bonding of all the services
- Explain the effective method of bonding
- Explain the use of appropriate SPDs in different service lines
- Explain the method of grounding

Key Messages:

- Importance equipotentialization
- Equipotential bonding
- Grounding

Session at a Glance

Timing	Topic	Method
10'	Activity 1: Introduction – Equipotential bonding	Brainstorming and presentation
10'	Activity 2: Importance of equipotential bonding	Presentation
15'	Activity 3: Use of Surge Protective Devices at service lines	Presentation
10'	Activity 4: Common Grounding	Presentation
5'	Synthesis and session evaluation	Question and answer

Duration



50'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - What is equipotential bonding? Why is it needed?
 - How to achieve equipotential bonding for service lines?
 - Selection of appropriate SPD at various service lines?
 - Grounding
- Provide handout describing the need of equipotential bonding for all the service lines along with the detailed layout of the equipotential bonding.

Process:

Activity 1: Introduction – Equipotential bonding / 10'

Explain the learning objectives and the outline of your session and the specific lessons they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain the importance of equipotential bonding
- Sketch the layout for the equipotential bonding
- Recommend the appropriate SPD at various service lines
- Explain the technique to achieve most effective grounding

Ask the participants why a bird perching on a high-tension transmission wire does not get electrocuted. Explain the importance of equipotential bonding. Show the video on lightning surges that may enter a building through various service lines rendering damages to the appliances. Explain why this happens.

Activity 2: Importance of equipotential bonding / 10'

Explain why an electrical current does not flow when two points under consideration are maintained at the same potential (equipotential) making an analogy with that flow of water from various heights. Explain the importance of acquiring equipotential zone for all the service lines and electrical installation.

Activity 3: Use of Surge Protective Devices at service lines / 15'

Explain the role of surge protective devices between the service lines and common bonding bar. Explain why a single surge protector can't be used in all service lines.

Activity 4: Common Grounding / 10'

Explain the importance of earthing/grounding of internal protection system. Explain the method of achieving a common ground for both internal protection system and external lightning protection system. Also discuss the possible hazards if there is a potential difference internal protection system and external protection system.

Synthesis and Session Evaluation / 5'

- Ask the participants about the need for equipotential bonding.
- Ask the participants if they have questions that require clarification and answer their queries if needed.

If there are no more questions, ask the participants if the discussions on the topic met their standards.

- Thank the participants and inform them of the next session.

Handouts

Provide the handouts on the Equipotential bonding that includes the detailed layout.

SESSION 3.3

Protecting Very Sensitive Public Buildings and Structures

Learning objectives:

At the end of the session, participants will be able to:

- Identify very sensitive public buildings
- Recommend the level of protection needed
- Recommend the class of SPDs needed at various sections of the building
- Explain the level of earthing to be achieved

Key Messages:

- Sensitivity of a building
- Level of protection

Session at a Glance

Timing	Topic	Method
10'	Activity 1: Introduction – Sensitivity of a building	Brainstorming and presentation
10'	Activity 2: Identification of level of protection	Presentation
15'	Activity 3: Effective grounding	Presentation
5'	Synthesis and session evaluation	Question and answer

Duration



40'

Materials



- Easel board and paper
- Videos and animations
- Charts
- Power point presentation/slides

Preparation



- Prepare power point/animation for the session objectives
 - What determines the sensitivity of a building?
 - How to achieve suitable level of protection for a building?
 - What is effective grounding?
 - Provide handouts that help identifying the sensitivity of a building in accordance with risk assessment.
-

Process:

Activity 1: Introduction – Sensitive building / 10'

Explain the learning objectives and the outline of your session and the specific lesson they expected to achieve from the session. At the end of the session, participants will be able to:

- Explain the sensitivity of a building
- Recommend the level of protection to a given building
- Explain the technique to achieve the most effective grounding

Ask the participants why the prescribed building is more sensitive than others. Explain the factors that determine the sensitivity of a building. Ask the participant to recall the risk assessment computation for the determining the sensitivity of a building.

Activity 2: Identification of level of protection / 10'

Engage the participants to use the various factors to obtain the sensitivity of a building at a given geographical location. After the computation is done, ask the participants to recommend an appropriate level of protection. If the building falls under the category of a very sensitive building, ask them to recommend the level one protection.

Activity 3: Effective grounding / 15'

Explain the importance of grounding and explain why some of the equipment are very sensitive to the earth resistance. Explain the methods of achieving effective resistance.

Activity 4: Common Grounding / 10'

Explain the importance of earthing/grounding of the internal protection system. Explain the method for achieving a common ground for both the internal protection system and external lightning protection system. Furthermore, discuss the possible hazards if there is a potential difference internal protection system and external protection system.

Synthesis and Session Evaluation / 5'

- Ask the participants if they have any question that require clarification and answer their queries if needed.

If there are no more questions, ask the participants if the discussions on the topic met their standards.

- Thank the participants and inform them of the next session.

Handouts

Provide the handouts on the internal and external protection system for sensitive public buildings to each participant.

Module 4

Field Assessment/ Hands on Training

SESSION

Session 4.1

Outdoor Activity- Measurement of Earth Resistance and Estimating the LPS Components on a Given Structure

Outdoor activity - Measurement of earth resistance, estimating the LPS components, etc.

Bring the participants to a public building, ask each of them to handle the earth resistance meter. Measure the value of resistance for the electrical grounding of that building. If there is any lightning protection installed on the structure engage the participants to measure the resistance of the grounding system. Involve the participants in taking the measurement of the dimensions (height, length and breadth) of the building. Assign them the task of designing the external protection system for that building. If a protection system is already in place, ask the participants to comment on the effectiveness of the protection system.

Annex

Annex 1 Pre/Post Test

Code:.....

1. Nepal is ranked in the world in terms of multi hazard vulnerability.
a. 21st b. 20th c. 30th d. 10th
2. According to the newly enacted DRR and Management Act (2017), the National Disaster Management Council is chaired by:
a. Prime Minister
b. Home Minister
c. CEO of National Disaster Management Authority
d. Home Secretary
3. Is lightning a threat to us?
Yes No
4. On average over the past ten years in Nepal the number of people killed annually due to lightning is
a. 10
b. 50
c. 100
d. Above 100
5. Lightning is a natural phenomenon.
True False
6. During lightning people are more vulnerable if they are
Inside a. Home/house b. Outside
7. We can swim during a storm with lightning strikes
True False
8. Can we protect infrastructure using proper lightning protection devices from lightning strikes?
Yes No

9. What should we do while outside home/house/building during lightning season?

- a. Stay away from big trees
- b. Do not walk in a water stagnant area
- c. If possible, stand in between and below high-tension electric poles
- d. All of above

10. What should we do to reduce casualties from lightning strikes?

- a. Include LPS in the Building Code and ensure its strong enforcement
- b. Mainstream PaL in academic curricula at all levels
- c. Mass scale public awareness on PaL
- d. All of above

Annex II

Training on Protection against Lightning

Training Evaluation

[Date: / /]

Location /Venue

Instructions: Please tick your level of agreement with the statements listed below	Strongly Agree	Agree	Disagree	Strongly Disagree	Not relevant to this event
1. The objectives of the training were met.					
2. The facilitators were good communicators.					
3. The course materials were relevant to my work.					
4. The facilitators were well prepared and able to answer any questions.					
5. The pace and time allocation of the course was appropriate to the content and attendees.					
6. The material was presented in an organized manner.					
7. I would be interested in attending a follow-up and advanced workshop.					
8. The exercises/role play were helpful and relevant.					
9. The venue was appropriate for the event.					
10. Course support team was helpful and provided timely information to facilitate my participation in the training.					

In your opinion, the level of this training was a) Introductory, b) Intermediate, or c) Advanced. (please circle your response)

11. Facilitators Rating

Please rate the facilitators in reference their knowledge, facilitation skills and responsiveness

		Excellent	Very good	Good	Average	Poor
Name of facilitator	His/her knowledge in the subject area is...					
	His/her facilitation skills are...					
	His/her ability to respect participants' views is...					
Name of facilitator	His/her knowledge in the subject area is...					
	His/her facilitation skills are...					
	His/her ability to respect participants' views is...					
Name of facilitator	His/her knowledge in the subject area is...					
	His/her facilitation skills are...					
	His/her ability to respect participants' views is...					
Name of facilitator	His/her knowledge in the subject area is...					
	His/her facilitation skills are...					
	His/her ability to respect participants' views is...					

12. Please list the three most useful takeaway from the course.

1. _____

2. _____

3. _____

13. Please list the three least useful sessions/materials in the training

1.

2.

3.

14. Are there any other topics that you would like to be offered training in?

15. Would you recommend this course to your colleagues/friends? Yes or No? Why?

16. Any other comments?

THANK YOU FOR COMPLETING THIS EVALUATION FORM. FEEDBACK RECEIVED WILL BE USED TO MAKE IMPROVEMENTS TO FUTURE EVENTS.

Annex III

Template for Training Report

Training on Protection of Structures against Lightning (PaL)

[Venue]

[Date]

1. Introduction

2. Training objectives

3. Profile of participants and facilitators

4. Proceeding (Information based on each session)

- Topics covered in each session
- Key issues raised by the participants
- Summary/takeaway of the group exercises (for each sessions)
- Desk-top Simulation exercise:
 - Scenario for the exercise
 - Materials used
 - Key observations
 - Lessons

5. Results of the Pre and Post tests

6. Results from the training evaluation

7. Conclusion (including key outcomes from the training)

8. Recommendations and learnings

9. Pictures with captions

10. Annexes (for report):

- Operational Plan from Participants
- Schedule
- List of participants

Annex IV: Sample Training Schedule

Day-1		Resource Person
09.00 – 09.30	Registration	
09.30 – 10:00	Opening, welcome and objectives of the training program	
10.00 – 10.10	Introduction of participants and facilitators	
10:10 – 11:00	Disaster Risk Management Policy & Institutional Mechanisms in Nepal	
11:00 – 11:15	TEA/ COFFEE BREAK	
11.15 – 12.00	Deleterious effects of lightning	
12.00 – 13.00	Role and initiatives of NAST	
13.00 – 14.00	Lunch	
14:00 – 14:30	Importance of Mainstreaming DRR into Development in Nepal	
14.30 – 15.30	Fundamentals of lightning (Technical session)	
15.30 – 16.00	General Discussion followed by tea	
16.00 – 17.00	Mechanism of lightning damage/injuries and safety tips	
17:00 – 17.15	Wrap up for the day	
Day 2		
08.30 – 08:45	Recap/Reflections from Day 1	
08.45 – 09.45	Protection of structures against lightning	
09.45 – 10.45	Risk assessment and estimating the air terminal (exercise)	
10.45 – 11.00	TEA/COFFEE and discussion	
11.00 – 12.00	Conventional against non-conventional LPS	
12.00 – 12.30	Discussion on bonding and grounding	
12.30 – 13.30	Lunch	
13.30 – 14.30	Internal Protection & Installation concerns of SPDs	
14:30 – 15:30	Discussions on Functionality of SPDs	
15.30 – 16.00	Group Presentation, Discussion + Tea/Coffee	

16.00 – 17.00	Measuring the earth resistance for proper grounding	Outdoor activity
Day 3		
08.30 – 08.45	Recap/Reflection from Day 2	
08.45 – 09.45	Lightning safety at the workplace	
09:45 – 10:45	Protecting very sensitive public buildings and structures	
10.45 – 11.00	Tea/Coffee break	
11.00 – 11.30	Discussion	
11.30 – 12.30	Protecting rural houses	
12.30 – 13.30	Lunch	
13.30 – 17.00	Demo of installation technique	Field work
17.00 - 17.30	Certificate awarding and closing	



ASIAN DISASTER PREPAREDNESS CENTER (ADPC)

Head Office

SM Tower, 24th Floor, 979/69 Paholyothin Road,
Samsen Nai Phayathai, Bangkok 10400 Thailand

Tel: + 66 2 298 0681 Fax: + 66 2 298 0012

Email: app@adpc.net



<https://app.adpc.net>



@AsiaPrepared



Asian Preparedness Partnership