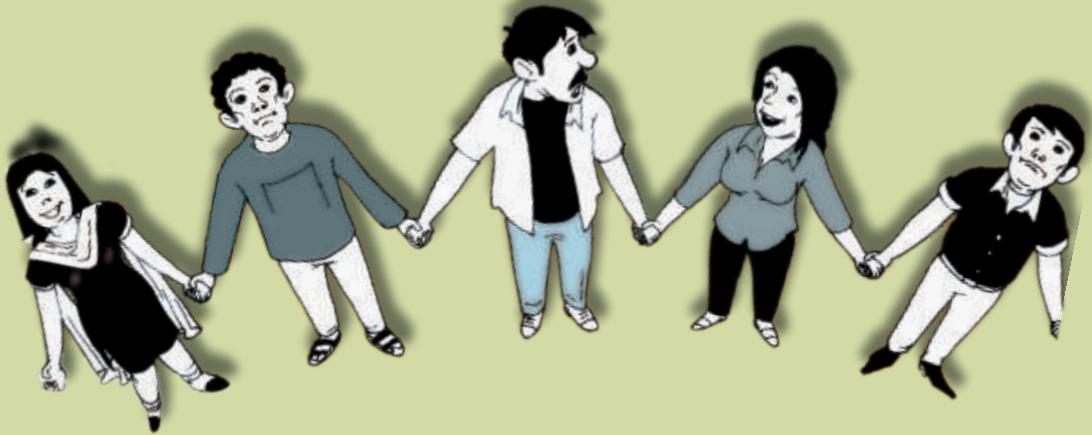




Part - II

PREPARED COMMUNITIES, SECURED COUNTRY



Hand Book for Training and Capacity Building of Civil Defence & Sister Organisation

April 2012



**NATIONAL DISASTER MANAGEMENT AUTHORITY
GOVERNMENT OF INDIA**

Part- II

HAND BOOK FOR TRAINING AND CAPACITY BUILDING OF CIVIL DEFENCE & SISTER ORGANIZATIONS



National Disaster Management Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations

A publication of:

National Disaster Management Authority
Government of India
NDMA Bhawan
A-1, Safdarjung Enclave
New Delhi – 110 029

ISBN : 978-93-8044-02-6

April, 2012

When citing this Hand Book, the following citation should be used:

National Disaster Management Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations – A publication of the National Disaster Management Authority, Government of India.
ISBN: 978-93-8044-02-6

The National Disaster Management Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations are formulated under the Chairmanship of Shri Jyoti Kumar Sinha, Member, NDMA in consultation with various stakeholders, regulators, service providers and specialists in humanitarian response from across the country.

Preamble

The Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations are published by the National Disaster Management Authority (NDMA) under Section 6 of the DM Act, 2005 for effective, efficient and comprehensive community based disasters management in India through the agies of Civil Defence and other such sister organisations. The vision of such effort is to minimize loss of life and property by enhancing the capacity of community for swift disaster management in the country.

Though the communities have been successfully managing disasters in the past, there are still a number of shortcomings which need to be addressed. The participation of community as a first responder in disaster situation has to be more comprehensive, effective, swift and well planned based on a well conceived approach to training.

Realisation of certain shortcomings in our community participation in disaster management and a desire to address the critical gaps, a core group of experts was constituted and four regional consultation workshops were conducted. It was ensured that representatives of the all CD training institutions of the country and MHA participate and their views given due consideration. The amended draft was again circulated to all States, UTs and their final comments were obtained and incorporated accordingly. Subsequently a comprehensive Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations has thus been prepared and published for its successful implementation.

Contents

Preamble	iii
Foreword	v
Preface	vii
Acronyms	ix
List of Supporting Materials	xiii
Note from the Users	xvii

Part I of this Hand Book contains :

Section 1

Introduction and Executive Summary

Section 2

**Disaster Scenario and Institutional Arrangement for
Disaster Management in India**

Section 3

Disaster and Management: Issues and Challenges

Section 4

Disaster and Development – Questions, Concept Clarifications

Section 5

Challenges of Volunteer Management in Disasters

Section 6

Gender, Vulnerable Groups, Psychosocial Support

Section 7

Training Service for Civil Defence

Section 8

Action & Practice/Training on Disaster

Section 9

Understanding Civil Defence Organisation

Section 10
Initiatives, Approaches and Strategies

Section 11
Additional Support Materials

Section 12

Introduction and Executive Summary 257

12.1. Introduction	259
12.2. Executive Summary	260
12.3. Introducing Sections, modules, units	262
12.4. Sample Structure & Plan for a Session	263
12.5. Suggested Training and Orientation Schedules	264
12.6. Guidelines for Facilitators/Trainers	264
12.7. How to use each subject as Standalone Module	268
12.8. Civil Defence Context	269
12.9. Evaluation of Training/Orientation course	269

Section 13

Responses to Hydro-Meteorological Disasters 271

13.1. Floods Hazards – Challenges and Response	273
13.2. Responding to Cyclone/Hurricane/Typhoon	295
13.3. Drought & Famine	307
13.4. Lightning and Thunder	317
13.5. Heat Waves and Cold Waves	324

Section 14

Responses to Geological Disasters 333

14.1. Earthquakes	335
14.2. Landslides	350
14.3. Tsunami: Causes, Consequences, Responses	355

Section 15

Responses to Industrial, Chemical Disasters & Nuclear/ Radiological Emergencies **367**

- 15.1. Responses to Chemical & Industrial Disaster 369
- 15.2. Nuclear and Radiological Emergencies: Preparedness and Response 384

Section 16

Responses to Accident related & other Disasters **417**

- 16.1. Road, Rail and Air Accidents 419
- 16.2. Fire Hazards 431
- 16.3. Riots, Violence and Stampede 440

Section 17

Responses to Biological Disasters **451**

- 17.1. Epidemics (Cholera, Malaria, T.B, HIV/AIDS, Bird Flu, etc.) 453
- 17.2. Agricultural Epidemics 466

Section 18

Additional Support Materials **469**

Annexure – I

Suggested Training and Orientation Schedule for three different types of Trainees:

- (A) Training and Orientation Schedules for Senior CD & other functionaries, Planners, Policy Personnel 471
- (B) Senior and Middle level Officials and Key Programme Personnel including Trainers 474
- (C) Key Volunteers of CD, NCC, NYKS, NSS, Scout & Guides, Red Cross, etc. 482

Annexure – II

- Registration Form 498

Annexure – III

- Session Evaluation Format 500

Annexure – IV

- Field Visit Evaluation Format 502

Annexure – V	
Training Evaluation Format	503
Annexure – VI	
Post Training Evaluation Questionnaire	505
Annexure – VII	
Disaster Vocabulary and Terminologies	507
Annexure – VIII	
Technical Terms and Measures of Radioactive Substances	518
Contact Us	524



Vice Chairman
National Disaster Management Authority
Government of India

Foreword

The changing global geo-political scenario is characterized by decreasing occurrence of traditional wars. However, at the same time there is increasing devastation to life and property from asymmetrical warfare, terrorism and other Natural and Man-made disasters. Such a scenario, warrants a greater role on the part of the civil defence in disaster management in the country. The civil defence being a community based voluntary organization can in addition to rescue, relief and rehabilitation, also play a stellar role in the field of community capacity building and public awareness and prepare the community to face any kind of disaster, as is being done in other countries.

Realizing the importance of civil defence, Group of Ministers had desired revamping of civil defence in the light of the fact that new and complex challenges have emerged and accordingly civil defence preparedness need to be undertaken and evolve a concrete action plan. Accordingly National Policy Approach Paper on Civil Defence Revamping has recommended the strengthening of the organization with a view to involve them in disaster management frame work.

Consequent upon GOI's decision to revamp the CD structure, NDMA in collaboration with Disaster Management Support Project of USAID India had initiated Nation wide consultation through regional meetings to identify the skill and training needs of CD cadre in the disaster management frame work and develop a comprehensive training Hand Book for CD & sister organization. Based on the input received from States & experts an excellent document has been produced in terms of Hand Book which will help trainers for the conduct of classes on disaster management aspects.

I express my deep appreciation for the wholehearted support and cooperation of various stakeholders in preparation of this Hand Book (Part I). My special appreciation for the efforts of Shri J.K. Sinha, Hon'ble Member, NDMA and his team of officers in finalizing the document.

*New Delhi
April, 2012*


*M. Shasidhar Reddy
(MLA)*



Member
National Disaster Management Authority
Government of India

Preface

The Indian subcontinent has been repeatedly hit by different disasters of terrifying magnitude with large scale devastation. Gujarat earthquake, Bihar floods, Odisha Super-cyclone or Tsunami in Tamilnadu, Andamans and Kerala have exposed the vulnerability of the country, its people, infrastructure and environment.

Disasters always need quick response to reduce the quantum of lives lost and property damaged. Past experiences has shown that the countries in which the government, the people and trained personnel joined hands together to face the calamities, recovered faster than the countries who were not prepared and so organized.

The National Policy Approach Paper on Civil Defence Revamping by Sri K.M.Singh, Member, NDMA have come out with a number of useful recommendations including training and capacity building. Armed with skills and proper equipments volunteer groups of the communities can play a vital role in managing disasters. The Policy paper advocates covering at least one per cent of the country's population under capacity building and community level preparedness. The Civil Defence organization has the potential to be a catalytic agent in this process. Realizing the need for a comprehensive training regime, the National Disaster Management Authority (NDMA), USAID and DMSP worked together to develop this Hand Book. It has been designed to meet the increasing need for training a critical mass of master trainers and cover various aspects of disaster preparedness and management in a user friendly manner supported by a variety of learning aids. It has a flexible structure so that each section can be detached and used a standalone module for a particular disaster and clientele.

Four regional consultations meetings held at Nagpur, Kolkata, Delhi and Thiruvananthapuram. It was a pleasure that a large number of DGs Civil Defence, Chief Wardens and Civil Defence Volunteers from all over the country participated in the and each one of them contributed their valuable suggestions. In this context the efforts of Sh. Mukund Upadhye IPS (Rtd), Sh. G. S. Saini, Director, National Civil Defence College Nagpur, Sh. A. Singh, IAS Secretary Civil Defence Govt.

of West Bengal, Sh. Rajan K. Medheker, IPS, Addl. Director General Civil Defence, Govt. of Kerala in providing knowledge based input are highly appreciated.

I would like to express my sincere thanks to the DM Division of MHA, former Director General Civil Defence & NDRF, Sh. Koshy Koshy, Ex-Executive Director, Sh. P.G. Dharcharbarty, Prof. Santosh Kumar and Col. Probodh K. Pathak from National Institute of Disaster Management, New Delhi and Prof. Vinod K. Sharma, Indian Institute of Public Administration, New Delhi for their valuable inputs.

I am also expressing my sincere thanks to Col J.R. Kaushik, Sr. Specialist (CD & NCC) Dr. M. C. Abani, Sr. Specialist, Maj. Gen V.K. Datta, Sr. Specialist (ME - CB), Maj. Gen R.K. Kaushal, Sr. Specialist (PP), Dr. Indrajit Pal, Associate Professor, CDM, Lal Bhadur Shastri National Academy of Administration, Mussoorie, Dr. Susanta Kumar Jena, Dr. Pavan Kumar Singh, and Sh. Nawal Prakash, Dr. Kumar Raka, Senior Research Officers, NDMA, Sh. Amod Kumar, Sh. Vinod Kumar Gupta, Dy. Chief Warden, Delhi Civil Defence and Sh. Rakesh Kumar Verma for extending unconditional support and assistance in the preparation of this document.

I also take this opportunity to thank Ms. Nina Minka, EX-Sr. DM advisor USAID India, Mr. N.M. Prusty, Ex-Chief of Party, Disaster Management Support Project and their team members and Praveen Kumar Amar, Disaster Management Consultant for the inputs & insights provided in developing and enriching this Hand Book.

I would like to place on record the significant contribution made by Prof. (Dr.) Bhagabanprakash, and the research team consisting of – Late Prof. Sibanarayan Mishra, Prof. Rabinarayan Panda, Dr. Mamata Dash, Sh. Radhakant, Sh. Chandrasekhar Rout and Sh. Shaktiranjan Patra.

Shri Binaya Bhusan Gadnayak, Specialist (IRS), NDMA requires a special mention for being instrumental in the entire efforts of preparation this training Hand Book.

Finally I would like to express my gratitude to Sh. M. Shashidhar Reddy, MLA, Vice Chairman NDMA and all the members of the NDMA for their guidance and suggestions in formulating this valuable document which will be of a great help for instructors to work out the methodology.



Shri J. K. Sinha,
Member, NDMA

New Delhi
April, 2012

Acronyms

AERB	Atomic Energy Regulatory Board
AHUs	Accident Hazards Units
BAIID	Breath Alcohol Ignition Interlock Devices
BIS	Bureau of Indian Standards
BMHRC	Bhopal Memorial Hospital & Research Centre
BW	Biological Weapons
CATS	Centralised Accident and Trauma Service
CBDP	Community Based Disaster Preparedness
CC	Climate Change
CD	Civil Defence
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CH ₄	Methane
CNS	Central Nervous System
CO ₂	Carbon Dioxide
CPR	Cardio-Pulmonary Resuscitation
CRED	Centre for Research on the Epidemiology of Disasters
CSIR	Council of Scientific and Industrial Research
CSO	Civil Society Organisation
DM Act	Disaster Management Act
DRR	Disaster Risk Reduction
EMP	Electro Magnetic Pulse
EOC	Emergency Operation Centre
ERC	Emergency Response Centre
ERTS	Emergency Response Teams
EU	European Union
FAMs	Fire Alert and Messages
FGD	Focus Group Discussion
FSI	Forest Survey of India
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GT	Gigatons

GLOF	Glacial Lake Outburst Flood
GW	Global Warming
HCN	Hydrogen Cyanide
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immuno Deficiency Syndrome
HPC	High Power Committee
ICC	Incident Command Centre
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDNDR	International Decade for Natural Disaster Reduction
IFRC	International Federation of Red Cross and Red Crescent Societies
IMCB	International Medical Commission on Bhopal
IMD	India Meteorological Department
IND	Improvised Nuclear Device
IPCC	Intergovernmental Panel on Climate Change
IRCS	Indian Red Cross Society
IRG	International Resource Group
IRS	Incident Response System
ITDG	Intermediate Technology Development Group
KPP	Key Programme Personnel
KV	Kilovolt
KVK	Krishi Vigyan Kendra
LCD	Liquid Crystal Display
LCE	Low-Carbon Economy
MAD	Mutually Assured Destruction
MCI	Mass Casualty Incident
MFIs	Micro Finance Initiatives
MIC	Methyl Iso Cynate
MMA	Mono Methyl Amine
MNCs	Multi National Companies
MSv	Millisievert
NaTs	Sodium Thi Sulphate
NASA	National Aeronautics and Space Administration
NCC	National Cadet Corps
NCDC	National Civil Defence College

NDRF	National Disaster Response Force
NIDM	National Institute of Disaster Management
NIMHANS	National Institute for Mental Health and Neuro Science
NMP	Neuro Motor Pathways
N ₂ O	Nitrous Oxide
NPPs	Nuclear Power Plants
NSS	National Service Scheme
NYKS	Nehru Yuva Kendra Sangathan
OHP	Overhead Projector
OYVs	Organisational of Youth Volunteers
PPE	Personnel Projective Equipment
PPm	Parts per million
PPP	Public Private Partnership
RDD	Radiological Dispersal Device
START	Simple Triage And Rapid Treatment
SCBA	Self Contained Breathing Apparatus
SDMA	State Disaster Management Authority
SHGs	Self Help Groups
(S)he	She/he
SLS	Supplementary Learning Support
SMSs	Short Message Services
SOPs	Standard Operating Procedures
SSG	Social Service Guides
TB	Tuberculosis
TED	Trad Environmental Database
TREMCARD	Transport Emergency Card
TREMDATA	Transport of Radioactive Material Data
UCC	Union Carbide Corporation
UCIL	Union Carbide India Limited
UNDRO	United Nations Disaster Relief Organisation
VCD	Video Compact Disc
WMD	Weapons of Mass Destruction
WMO	World Meteorological Organisation
YRC	Youth Red Cross

List of Supporting Materials

List of Supporting Materials

(Handouts, Slides, Case studies,
Tables, Diagrams, Maps and Visuals.)

Section 13

Handouts

Floods, p277
 Cloudburst, p278
 Coastal Erosion, p279
 Dealing with Floods, p282
 Can Dams and Levees Reduce the Risks of Floods, p285
 Report on Koshi Flood' 08, p285
 Effects of Floods, p287
 What to do During a Flood, p288
 Flood Safety, p290
 What to do After a Flood, p290
 Case Study - Urban Flooding: The Mumbai Experience, p292
 Lessons learnt from Odisha Super Cyclone, p298
 Tropical Cyclone, p300
 National Cyclone Risk Mitigation Project - Major Components, p302
 Classification of Cyclonic Disturbances (IMD Scale), p303
 Design Considerations for Buildings, p304
 Droughts in India - Some Basic Facts, p309
 Do's and don'ts of Drought, p312
 Lightning, p319
 Thunder, p320

Short Quiz on Lightning, p320
 Damages Caused due to Lightning and Thunder, p321
 Heat Wave and its Impact, p326
 What you should do during Extreme Heat Wave, p329
 Cold Waves- Impacts and Counter Measures, p330

Slides

Flowchart for Flood Forecasting and Early Warning, p284
 National Cyclone Risk Mitigation Project, p302
 Classification of Cyclone Disturbances, p303
 Cyclone Response Mechanism, p306
 Information Requirement for Drought Assessment and Source, p310
 List of Major Famines, p316
 Symptoms & First Aid of Heat Disorders, p328

Maps

Flood Hazard Map of India, p276
 States Affected by Drought in India, p314
 Drought prone Regions of India, p315

Section 14

Handouts

Lessons learnt from Gujarat Earthquake, p344
Earthquake Disaster Management Plan -Salient Features, p346
Landslides in India, p352
Land sliding and Avalanches, p353
Earthquake and Tsunami, p357
Tsunami Characteristics, p358
Tsunami Signs and Warnings, p359
Retreat and rise cycle of the Tsunami, p360
Economic and Environmental Impacts on Tsunami, p363
Characteristics of Tsunami, p363
Lessons Learnt from Tsunami, p365

Slides

Do's and don'ts Before an Earthquake, p340
Do's and don'ts During an Earthquake, p341
Do's and don'ts After an Earthquake, p342
Dangerous Earthquakes, p343
List of Lifeline Structures requiring Structural Safety Audit, Seismic Strengthening and Retrofitting, p348
Critical Areas of concern for Earthquake Management, p349

Maps

Earthquake Zone Map of India, p338
Seismic Observatories of IMD, p339
Landslide Vulnerability Atlas of India, p354

Countries affected by Indian Ocean Earthquake triggered Tsunami' 2004, p362

Diagram

Six Pillars of Earthquake Management, p345

Section 15

The Bhopal gas disaster, p372
Structure of Atom, p388
External and Internal Dose, p391
Protection form Radiation, p392
Sources of Radiation (Natural and man made), p392
Contamination and Decontamination, p394
Biological Effects of Nuclear Radiation, p395
Personal Protective Equipment (PPE), p397
Nuclear and Radiological Emergency/ Disaster Scenarios, p397
Acidents in Nuclear Power Plants and other Facilities in Nuclear Fuel Cycle, p398
Nuclear/Radiological Terrorism and Sabotage at Nuclear facilities, p399
Nuclear Weapons and their Effects, p400
Emergency Preparedness, p405
Role of First Responders, p407
Do's and don'ts following a Nuclear Accident Explosion, p412

Slides

Penetration from Ionizing Radiation, p391

Acute Radiation Syndrome for Gamma Radiation, *p396*
Physical Characteristics of Nuclear Explosions and their Effects, *p402*
Community Development, *p406*
Counter Measures, *p411*

Figures & Tables

The Atom, *p390*
Energy Distribution of a Fission Nuclear Device, *p403*
General Details of A-Bombings (1945) and their Effects, *p404*
Suggested Radius of Inner Cordoned area for Radiological Emergencies, *p409*
Flowchart for Response Action by the First Responder, *p410*

Section 16

Report: India Tops the List of Road Deaths Across the World!, *p421*
Case Study - Train Accident: Sabarmati Express, *p422*
Handout on Air Accident and Aviation Safety Tips, *p423*
Top 10 Airline Safety Tips, *p427*
Travel Tips: How to Avoid and Survive a Plane Attack, *p429*
Handout on Fire Hazards and Risk Reduction Measures, *p433*
Slide on Fire in Urban Areas – What to do, *p438*

Slide on Fire in Rural Areas – What to do, *p439*
Handout on Riots/Violence – Do’s and Don’ts, *p442*
Stampede: Do’s and Don’ts, Guidelines, *p442*
Case Study of Chamunda Devi Temple Stampede, *p443*
A Discussion on the Stampede during Puri Ratha Yatra, *p445*
Slide on Recent Stampedes in India & World, *p447*
Slide on Crowd Management in some of the Sacred Places in India, *p448*
Slide on Stampedes kill more Indians than Blasts, *p449*

Section 17

Handout on Pest Attacks, *p468*
Handout on Cattle Epidemics, *p456*
How to Prevent Food Poisoning during Disasters, *p456*
Handout on Biological Warfare Agents: Past and Present, *p457*
Handout on Environmental Management, *p460*
Handout: Disposal of Animal Carcasses – A Prototype, *p461*
Handout on Patient Isolation Precautions, *p464*

List of Supporting Materials

Note for User

Dear User of this Hand Book for training and capacity building of Civil Defence and Sister Organisation (Part I),

I am sure, you may be aware of the following frightening facts. Yet all of us together can make our community safer and the country prepared by promoting knowledge, awareness and skill among the people to work as first responders to any disaster.

Some Hard Facts

- a) **Dec 9th 2011** – AMRI hospital fire - Kolkata - 90 patients died of suffocation.
- b) **Aug 13th 2010** – Leh - Cloud Burst - 33 Soldiers of the Indian Army went missing 1113 dead and 500 habitant missing in Leh.
- c) **Nov 11th 2009** – Fire at IOC, Jaipur - 12+ person died, 150+ people injured.
- d) **Aug - Sep 2008** – Kosi Floods - Over 30 lakh people in 1,598 villages spread over 15 districts were affected by the floods.
- e) **Year 2008** – At least 1000 people around India were killed in monsoon rains.
- f) **June 2005 Gujarat Flood** – More than 250,000 people evacuated. The loss due to flooding was estimated to be over Rs. 8000 crore.
- g) **26 December 2004** – In India, at least 10,136 people were killed and hundreds of thousands were rendered homeless by the Tsunami.
- h) **January 26, 2001** – The earthquake with Bhuj its epicenter, killed more than 20,000 people, injured another 167,000 and destroyed near a million homes throughout Gujarat.
- i) **October 1999** – Odisha supercyclone caused the deaths of over 10,000 people . Approximately 275,000 homes were destroyed, leaving 1.67 million people homeless.

- j) **17th August 1998** – About 380 people were killed and the entire village washed away by massive landslides at Malpa in Uttarkhand.
- k) **September 30, 1993** – Latur earthquake killed approximately 7,928 people and injured another 30,000.
- l) **2003 to 2008** – In India more than 1131 people have died and thousands injured in various incidents of temple stampedes, latest being the Chamunda Mata temple tragedy in Jodhpur.
- m) In the last eight years, there have been 21 bomb blasts in different parts of India, leaving 806 people dead and several hundreds injured.
- n) **May 20, 2008** – Illicit liquor death in Bangalore / Krishnagiri, toll was 156.
- o) **February 27 to march 3, 2002** – Godhra Train Burning and subsequent communal violence affected 151 towns and 993 villages in fifteen to sixteen districts of Gujarat. Approximately 1044 people of both the communities were killed in the violence.
- p) **July 21, 2001** – four carriages of Mangalore Mail train were derailed and fell into Kadalundi River killing of 57 people and injuring 300.
- q) **December 24, 1999** – Indian Airlines Flight 814 was hijacked to Afghanistan.
- r) **June 13, 1997** – 59 people died and over a hundred were seriously injured in Uphaar cinema fire.
- s) **12 November 1996** – Charkhi Dadri mid-air collision of Saudi Arabian Airlines Flight 763 with Air Kazakhstan Flight 1907 killed all 349 people on board.
- t) **23 December 1995** – A tent fire in Dabwali, Haryana killed 360 people
- u) **December 3, 1984** – Approximately 20,000 died in Bhopal gas leak.

These natural and manmade disasters in India in recent years underline a need for disaster preparedness on war footing.

This training Hand Book is an attempt to present before you a series of learning events on disaster management, keeping in view the training needs of Civil Defence, Home Guards and other volunteer based organisations.

How this Hand Book was prepared

A Training Needs Assessment (TNA) was undertaken in all the four regions of the country before developing this document. The representatives of different organisations working on disaster management at various levels participated in it and gave their feedback.

As regards the disaster preparedness and response in the TNA, most of the respondents Stated that their present areas of focus were - **search and rescue, emergency relief, risk information, communication and community awareness**. Many of them, however, pointed out that there are knowledge and skill gaps in - **emergency preparedness, basic communication, conflict resolution, leadership and motivation skills, Incident Response System, environment and epidemics control, volunteer management, psychosocial support, ethics, gender, addressing needs of vulnerable groups, nuclear radiation hazards, minimum standards of disaster response, coordination with volunteer organizations and civil society groups as well as training methodology**.

Similarly, the most preferred training methods by the participants were – **audiovisual, participatory and experiential learning and field study as well as practical learning**. Classroom lectures were the least preferred. Some respondents emphasized the importance of **planning, teamwork, organization, networking, alliance building and pre disaster preparedness**. The need for a differential approach for various categories of trainees was also emphasized.

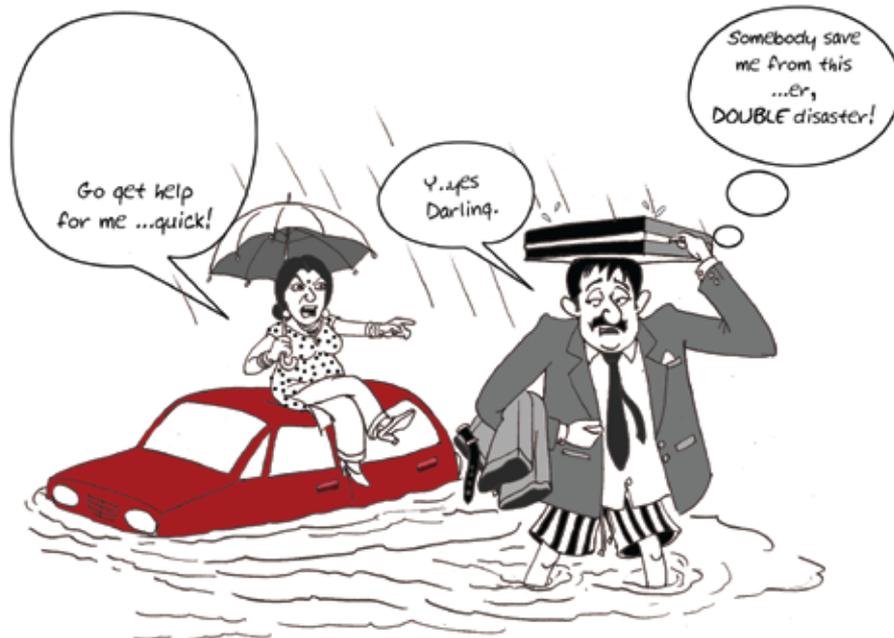
The Hand Book addresses most of these concerns. However, the real success would depend on the imagination, innovation and creativity of the facilitators and master trainers while implementing the training plan and sessions.

How to Prepare the Training Program

It is recommended that well before the training begins, the Course Coordinator and the Training Team must go through the **section 1** entitled **Preparedness and Guidelines**. It is also expected that all the facilitators and trainers are familiar with various types of

training methods and skills as explained in **section 2** and **section 3**; and also have an understanding of the Civil Defence Organisations and their roles and responsibilities. Resource persons invited from outside the training institutions need to be adequately briefed about the objectives and methods.

Training is the best tonic for sustaining the motivation and competency level of a volunteer / volunteer based organisation. Organisations like Civil Defence need adequate number of **competent, proactive, committed** and **highly skilled** persons to work in an open, informed, participatory environment with focus on team work. Only training and retraining on regular basis could promote such professional, attitudinal and behavioural changes. It can sustain their interest, motivational level and keeps them connected with the cause and the community.



Section 12

Introduction and Executive Summary

Content

12.1.	Introduction	259
12.2.	Executive Summary	260
12.3.	Introducing Sections, modules, units	262
12.4.	Sample Structure & Plan for a Session	263
12.5.	Suggested Training and Orientation Schedules	264
12.6.	Guidelines for Facilitators/Trainers	264
12.7.	How to use each subject as Standalone Module	268
12.8.	Civil Defence Context	269
12.9.	Evaluation of Training/Orientation course	269

Section 12

12.1. Introduction

The citizens of India have long been helpless victims of various natural and manmade disasters. But with increasing awareness and new policies, plans and strategies to meet the challenges, the situation has improved lately. Worldwide the number of disasters has increased from about 50 in the 1950s to 700 towards the end of 20th century. In view of the deaths and destruction wrought by a series of devastating disasters in different parts of the world, the United Nations observed the decade following 1990 as the International Decade for Natural Disaster Risk Reduction (IDNDR). The IDNDR was followed by the world Conference on Disaster reduction at Kobe in Japan in January' 2005. During this period India was hit by three super disasters, i.e. the Latur earthquake of September 30, 1993, the Odisha Super cyclone of October 1999 and then Gujurat earthquake of 26 January, 2001 while the country was celebrating it's Republic Day. The ruthless and relentless blows of these disasters exposed the inadequate preparedness of the country at various levels. The need was felt for building a disaster intelligent and disaster resilient community led by an efficient disaster management structure.

The importance attached to disaster preparedness by the World and Media can be gauged by the fact that :

- a) A world conference on Disaster Reduction was organised in January, 2005 at Kobe, Hyogo, Japan and action plan prepared to make a Disaster resilient world.
- b) India was also a participant and agreed to the action plan.
- c) The High Power Committee (HPC) recommended the enactment of a Disaster Management Act and also suggested a framework of the institutional arrangement for effective DM.
- d) The DM Act passed in December, 2005 under entry 23 of the concurrent list of indian constitution to strengthen the DM initiatives in the country. The DM Act, 2005 created the National Disaster Management Authority (NDMA), headed by the Prime Minister and the State Disaster Management Authority (SDMA) by Chief Ministers. The Act also created National Disaster Response Force. Presently it consist 10 Bn. which is fully trained and equipped to handle all types of disasters. The NIDM which had been created earlier under the MHA was brought under a governing body headed by the Vice Chairman of the NDMA. It was realized that large-scale training and capacity building on disaster issues coupled with massive community awareness and preparedness, would be the key element for building a safer India.

- e) Earlier in 2001, a High Power Committee (HPC) constituted by the Govt. of India had recommended involvement of Civil Defence in Disaster Management and keeping it in a State of continuous preparedness. Later the Home Ministry constituted a committee headed by a member of the NDMA Shri K.M. Singh to submit a comprehensive report on the revamping of the Civil Defence in the country. This Report also envisaged that a revamped Civil Defence could make trained manpower available to the State, district and local administration whenever there is any disaster. Civil Defence would be a community-based effort run by socially motivated trained volunteers. It believes that government and the community should work together in a synergy manner to meet any disaster. The committee recommended that Civil Defence should take up their new added role in community capacity building and public awareness in close coordination with Panchayati Raj Institutions (PRIs) and urban local bodies/Municipalities/Corporations.
- f) It was also suggested that the Civil Defence, primarily being a volunteer based organization with a skeletal regular staff, should use

the services of other volunteer based organizations to supplement its resources in an overstretched disaster scenario. It should also collaborate with student and non-student youth organizations like the NCC, NSS, Scouts and Guides, NYKS to synergise efforts and resources for the common cause of disaster management. The process could be further strengthened by capacity building measures in order to develop a trained human resource. The concept and orientation of Civil Defence was also changed from "town-specific" to "district specific" in order to cover the whole district and the entire country. Every district now will have a group of volunteers spread all over the district trained to respond in case of Disaster.

12.2 Executive Summary

12.2.1 Stakeholders and Users of the Hand Book

This Hand Book has been designed and developed to cater to the training and orientation needs of the following category of users / stake holders. The Hand Book is flexible, parts of which could be used to the specific focus areas of disaster management functions being done by different agencies in different vulnerable areas.

- a) National / Regional level CD institutions and Trainers
- b) CDTI Faculty
- c) NCC Trainers / Programme Personnel
- d) NSS Trainers / Programme Personnel
- e) NYKS Trainers / Programme Personnel
- f) Red Cross Trainers / Programme Personnel
- g) Scout and Guides/trainers / Programme Personnel /Volunteers
- h) Home Guard Trainers
- i) CD Volunteer Trainers and key Volunteers
- j) Home guard Volunteers
- k) NCC, NSS, NYK key Volunteers
- l) Red Cross Volunteers
- m) Civil Society Organizations / NGOs / Youth

12.2.2 Objectives of the Hand Book

- a) To promote awareness on various types and aspects of disaster and its challenges;
- b) To improve competency and skill level of Civil Defence trainers and volunteers on Disaster Management;
- c) To enable trainees to develop Action Plans on Disaster management, Mitigation and Risk reduction at all stages;
- d) To promote understanding of Disaster Management policies, principles, plans, practices, initiatives and structures at National and International Level and
- e) Building the capacity of Civil Defence personnel to work as **Master Trainers**.

12.2.3 Introducing Sections, Modules, Units

This Hand Book is consisting with section 12 to 17. In this Part of the Hand Book we have discussed issues and needs of (13) Responses to Hydro-Meteorological Disasters, (14) Responses to Geological Disasters, (15) Responses to Industrial, Chemical Disasters & Nuclear/ Radiological Emergencies, (16) Responses to Accident related & other Disasters, (17) Responses to Biological Disasters and (18) Additional Support Materials.

12.3. Introducing Sections, Modules, Units

Part-II of the Hand Book has 12-18 sections. All of them are thematic in nature and contain required handouts, supplementary materials have been placed in section 18 in the form of annexures.

Section 12

Entitled '**Executive Summary and Introduction**', this section introduces the module as a whole along with the objectives, introducing Sections, modules, units, sample structure & plan for a session, suggested training schedules for the three categories of CD personnel, note for the trainers, and how to use parts of the present Hand Book as standalone modules and evaluation of Training/Orientation course.

Section 13

Gives an overview of '**Response to Hydro-Meteorological Disasters**' and deals with Floods Hazards-Challenges and Response, Responding to Cyclone/Hurricane/Typhoon, Drought & Famine, Lightening and Thunder, Heat Waves and Cold Waves

Section 14

'**Responses to Geological Disasters**' focuses on Earthquakes, Landslides, and Tsunami. It also deals with Lessons Learnt

form Gujarat Earthquake, Earthquake Disaster Management Plan-Salient Features, and Landslides in India for effective learning

Section 15

'**Responses to Industrial, Chemical Disasters & Nuclear/Radiological Emergencies**' basically aims at Industrial and Chemical Disasters, Nuclear/radiological emergencies, preparedness and response, and Supplementary Learning Support materials. This section also explores Bhopal gas disaster, Structure of Atom, External and Internal Dose, Protection from Radiation, Sources of Radiation (Natural and man made), Contamination and Decontamination, Biological Effects of Nuclear Radiation, Personal Protective Equipment (PPE), Nuclear and Radiological Emergency/ Disaster Scenarios, Accidents in Nuclear Power Plants and other Facilities in Nuclear Fuel Cycle, Nuclear/Radiological Terrorism and Sabotage at Nuclear facilities, Nuclear Weapons and their Effects, Emergency Preparedness, Role of First Responders, Do's and don'ts following a Nuclear Accident Explosion, etc.

Section 16

'**Responses to Accident related & other Disasters**' deals with Rail, Road and Air Accidents, Fire Hazards, and Riots, Violence and Stampede

Section 17

'Responses to Biological Disasters'

basically deals with Epidemics (Cholera, Malaria, T.B., HIV/AIDS, Bird Flu, etc.). Materials and handouts also provides for Pest Attacks, Cattle Epidemics, Biological Warfare Agents : Past and Present, Environmental Management, Disposal of Animal Carcasses, and Prevention of Food Poisoning during disaster.

Section 18

'Additional Support Materials' deals with Suggested Training and Orientation Schedule for three different types of trainees, Disaster Vulnerability and Terminologies, Registration format, Session evaluation format, and Training evaluation format in the form of annexures.

12.4. Sample Structure & Plan for a Session

A standardized and uniform structure has been developed for all the training sessions of this Hand Book. A sample structure of each session plan is given below.

Part- 1

- a) Subject/Theme;
- b) Introduction and Module Overview;
- c) Objectives;

- d) Methods;
- e) Materials/Learning Aids;
- f) Duration;
- g) Expected learning outcome;
- h) Cognitive / Knowledge related;
- i) Competency / Skill related;
- j) Sub-themes / Key learning points and issues;
- k) Important lessons learnt;
- l) Activity;
- m) Note to the trainer; and
- n) Further study / References.

Part-2

- a) Do's and Don'ts, guidelines; and
- b) Supplementary Learning Support Material.

Session Duration

The duration of each training session should be one and a half hours in the forenoon and one hour fifteen minutes in the afternoon. For practice training in the field the duration of the session could be stretched up to two hours if the situation so demands.

12.5. Suggested Training and Orientation Schedules

The **training schedules** for three broad categories of CD cadres namely **(i) senior level CD, Home Guard and other senior functionaries working on disaster management issues. (ii) Mid-level Officials and Key Programme Personnel including trainers and, (iii) Key volunteers of CD, NCC, NYKS, NSS, Scout & Guides, Red Cross, etc.** are given in **Annexure-II, III, and IV** respectively.

The training content for each category has been chosen accordingly. For instance, since the training duration for senior level functionaries is for only one day, the content is broadly limited to policies, strategies, structures and functions, innovations and new initiatives and latest developments on the issue. Similarly for the one-week and two-week programmes aimed at the second and third category, the content covers more subjects, issues and practicals. A separate Hand Book on training service has also been developed to be used by **CD Training institutions** to create a critical mass of **master trainers**.

12.6. Guidelines for Facilitators/Trainers

- a) This Hand Book can help the trainer/facilitator in a number of ways, but it is not to be taken as the final word. The trainer/facilitator would have to decide which part (s)he would like to use. One may even have to add/modify some of the approaches and exercises to suit the particular environment and culture (s)he works in;
- b) After thoroughly going through the contents of Modules/Sections in this manual one should focus on the areas which (s)he thinks are most useful and relevant to the participants and which they themselves would want to know more about;
- c) Selecting the learning activities and adapting them to suit the special needs of the trainees are best done by the trainer guided by training assessment;
- d) A very important thing to remember when trying out sample activities or developing new ones is to assess how suitable they are for use in the localities and organizations of the participants;
- e) The activities adopted during the

training must always be appropriate to the experience level, cultural orientation and circumstances of the participants;

- f) Activities should always be pre-tested before they are used during a training programme. They can be modified for different age groups, made more relevant to local circumstances, and discussion/questions can be adjusted or simplified where necessary;
- g) Secondly, special care is needed when developing or adapting activities for use the participants/volunteers who are illiterate or who only have basic literacy skills;
- h) In some of the activities included here, for example, it is suggested that someone in each small discussion group should write down a summary of what is said and use it to report back later to the larger group;
- i) This need not be a problem. Intelligent people who are not able to write usually have a very good memory, and can generally report back on group discussions without too much difficulty;
- j) Further, it should be remembered that flexibility is the key to success in every learning activity. A trainer/

facilitator should never be afraid to cut short an activity if participants do not seem to be interested or have nothing to say;

- k) If this happens, use it as a positive opportunity or evaluation. Ask participants what they feel about it, what they did not like, and how it could have been made more relevant or useful to them;
- l) **Getting started:** Having established a need for the disaster management programme the facilitator must find a way to begin it. A session well begun is half done; and
- m) **Climate building:** In order to find out what can be a challenging area for disaster, it is essential to spend sufficient time on climate building and creating a proper atmosphere. Participants will need time to get to know each other, to establish what they want from the course, and to agree on how they are to work together as a group. This is important, regardless of the length of the session or course.

There are numerous ways of getting participants to introduce themselves. Here are five examples.

<p>Name and Introduction</p> <p>Each participant present in the session (starting with the trainer) writes on the board or a sheet of paper his/her first or pet name and a short sentence about oneself.</p>	<p>Personal Identification</p> <p>Place sheets of coloured paper in the centre of the floor together with coloured felt top pens. Explain to participants that you would like them in turn, when they feel ready, to take a pen and write their first name on the paper and say something about themselves, for example what they like about their name, what they like to be called, etc. You should begin and model this exercise. When all the names are on the pieces of paper, these should be displayed (e.g. stuck on the wall) for future reference. It also helps trainers to remember the names of the participants.</p>	<p>know each other. Ask participants to go around and say who they are and something about themselves, which nobody in the group knows.</p>
<p>Pairs Introduction</p> <p>Ask participants to find someone they do not know, and to spend a few minutes telling each other some things about themselves e.g. their name and something they would like others in the group to know about them. Ask each pair to find another pair with whom they are to repeat this exchange. Then ask participants to go around and repeat this with the whole group.</p>	<p>What nobody knows about me</p> <p>This is a useful exercise when people already</p>	<p>What we want to know about each other</p> <p>Ask participants to generate a list of things they would like to know about each other. As they do so, write them onto a flip-chart. Depending on the size of the group the next part of the exercise can be done either in plenary or in small groups. Then ask them in sequence to introduce themselves covering the topics from the list, with which they feel most comfortable. This exercise, particularly when conducted in small groups, can help to develop a sense of intimacy.</p>

n) Agenda-Building

It is important at the beginning of a course to clarify why participants are attending the training course. It is also useful to ask what participants expect from the course and also what they will contribute, emphasizing

that this style of learning is based on mutual respect and sharing. In addition to clarifying what participants want from the training programme, it is also useful to identify specifically how they would wish to improve in their work as a result of attending the course.

o) Ground Rules/ Favourable Working and Learning Conditions

If a group is to work effectively and learn together, it needs to have a shared understanding. Identifying ground rules or learning conditions is also useful in helping a group to form and begin working together

There are several ways of doing this. Whichever way is chosen it is important that **participants themselves decide the rules** by which they wish to work and which are acceptable to the whole group. This can be displayed on the wall and the invitation extended to participants to alter these as the courses or session progresses. Some matters you may wish to bring to the attention of participants include:

- i) CONFIDENTIALITY;
 - ii) PUNCTUALITY;
 - iii) THE RIGHT TO 'PASS';
 - iv) THE OPORTUNITY TO TAKE RISKS;
 - v) THE RIGHT TO CHALLENGE;
 - vi) MAKING 'I' STATEMENTS;
 - vii) CORRECT BEHAVIOUR;
 - and
 - viii) NO SMOKING, etc.
- p) Alternatively, it might be helpful to explain to participants that rather than talking of 'rules' which imply

penalties if infringed, it is usually more helpful to think in terms of behaviour and attitudes which the group needs to have if it is to be able to get on with the task which has brought it together.

It is therefore essential to explain this style of working at the start of any course and to ensure that people are willing to **contract** into it. In the ground rules or learning conditions it is important to discuss this notion of allowing ourselves to be challenged emotionally and intellectually. Realising this, the course introduces the **notion of challenging**.

q) Before the Training Session

- i) The trainer/facilitator needs to be prepared for the training session before it starts. One should prepare the teaching points by reading the introduction, overview and other learning support materials in the Hand Book. Also (s)he may add to her/his knowledge by additional reading, consulting other experts in the concerned subject/theme/ sub-theme;
- ii) **The trainer/facilitator as well as the participants must be comfortable** in talking with each other.

- One's attitude is reflected in one's words, gestures, facial expression, and tone of voice and choice of words;
- iii) **The physical atmosphere** is equally important. The room should be spacious, well ventilated and with good lights. Drinking water should be provided;
 - iv) A **black/white board**, chalk and duster or large sheets of paper, or if these are not available, old newspapers on which a felt pen or charcoal may be used. **Pencils, papers, felt pens** for the participants should be stocked;
 - v) If an **overhead projector** is available, transparencies/sheets should be projected;
 - vi) A screen would be helpful (if not, use a white wall or sheet), particularly if a **slide projector** for 35 mm slide is available. If a video and TV set is available, use it only if an appropriate video film for the session is available. Be sure you have seen it before the training session. Place it at the point you wish to show it. Videos usually help to initiate a discussion, or strengthen a point that is being emphasized. It could also be a quick summary of the session e.g. "Growing Up";
 - vi) Depending on the number of participants, a **microphone and amplifier** may be required;
 - vii) Through the amplifiers a cassette recorder can **tape any special talk** e.g. by a doctor or any other specialist; and
 - viii) Choice of audiovisual medium should be decided with care. When '**once only**' material is needed for an informal audience, use **flip chart/OHP**. For a **lecture** arrange a **writing board**. When visual must be **altered** use **OHP/Magnetic board**. When materials are **more**, use **slides**. For preparation of **in-house material**, use **OHP**. When **on-line data** must be displayed use **Video Data Projector**. When presentation is to be given to senior policy makers **power point projector** should be used.
- ### 12.7. How to use each subject as Standalone Module
- This is a comprehensive Hand Book to implement, for which, the minimum duration would be about two weeks. This Hand Book is flexible and contains a

number of sections and each section has a number of sessions/units. Similarly each unit or session has a number of sub themes and key issues/learning points. However the Hand Book has been designed in such a way that each section could be taken out and used as a standalone module and can be organized as a separate training course or workshop. For instance in section 7 entitled Responses to Climate & water related disasters there are 7 units out of which one unit i.e., Cyclone could be taken out and used as a 'Standalone' training module. In that case, each sub theme under the main theme could be assigned one or two sessions depending on the need of the trainees. An imaginative facilitator can find this process easy to implement.

12.8. Civil Defence Context

In section 4 of this Hand Book, the civil defence organizations have been presented in details. Yet, whenever a particular session is used as a standalone module, it should be prefaced with a brief presentation on civil defence and its new role in disaster management.

12.9. Evaluation of Training/ Orientation course

a) Training is a planned and structured activity with the objective of transferring knowledge, information, skills, competencies, and also inculcating

the needed attitude, behaviour, and practices in the trainee;

- b) It is, therefore, very important to initiate a **concurrent evaluation** of the process as well as the content at various levels from the very beginning;
- c) It is desirable that **after each session** at least 5 minutes is devoted to **topics covered** in the session, rating of its presentation by the resource persons and the actual learning achieved. Find out whether the **key objective** of the session has been met;
- d) Similarly in each succeeding day, during the **Recapitulation** the performance of the **previous day** can be assessed through feedback from the participants;
- e) At the end of the course, there should be a **full course evaluation** so that corrective measures could be taken in future;
- f) Some specimen evaluation format is given in Annexure which can be adapted/modified according to the nature of the training course to be offered; and
- g) In fact, the evaluation process should begin with the Registration form (given in the same Annex.) through

which the training organization can obtain feedback about the trainees and their expectations. The **formats** annexed are:

- i) Session Evaluation;
- ii) Field Visit Evaluation;
- iii) Course Evaluation and Post-course Evaluation for the Trainees;

- iv) Post-course Evaluation for Employer Organization; and
- v) Course Director Evaluation.



Section 13

Responses to Hydro-Meteorological Disasters

Content

13.1.	Floods Hazards – Challenges and Response	273
13.2.	Responding to Cyclone/Hurricane/Typhoon	295
13.3.	Drought & Famine	307
13.4.	Lightning and Thunder	317
13.5.	Heat Waves and Cold Waves	324

Supplementary Learning Support materials

Handouts

- ★ Floods, *p277*
- ★ Cloudburst, *p278*
- ★ Coastal Erosion, *p279*
- ★ Dealing with Floods, *p282*
- ★ Can Dams and Levees Reduce the Risks of Floods, *p285*
- ★ Report on Koshi Flood' 08, *p285*
- ★ Effects of Floods, *p287*
- ★ What to do During a Flood, *p288*
- ★ Flood Safety, *p290*
- ★ What to do After a Flood, *p290*
- ★ Case Study - Urban Flooding: The Mumbai Experience, *p292*
- ★ Lessons learnt from Odisha Super Cyclone, *p298*
- ★ Tropical Cyclone, *p300*
- ★ National Cyclone Risk Mitigation Project - Major Components, *p302*
- ★ Classification of Cyclonic Disturbances (IMD Scale), *p303*
- ★ Design Considerations for Buildings, *p304*
- ★ Droughts in India - Some Basic Facts, *p309*
- ★ Do's and don'ts of Drought, *p312*
- ★ Lightning, *p319*
- ★ Thunder, *p320*
- ★ Short Quiz on Lightning, *p320*
- ★ Damages Caused due to Lightning and Thunder, *p321*
- ★ Heat Wave and its Impact, *p326*
- ★ What you should do during Extreme Heat Wave, *p329*
- ★ Cold Waves- Impacts and Counter Measures, *p330*

Slides

- ★ Flowchart for Flood Forecasting and Early Warning, *p284*
- ★ National Cyclone Risk Mitigation Project, *p302*
- ★ Classification of Cyclone Disturbances, *p303*
- ★ Cyclone Response Mechanism, *p306*
- ★ Information Requirement for Drought Assessment and Source, *p310*
- ★ List of Major Famines, *p316*
- ★ Symptoms & First Aid of Heat Disorders, *p328*

Maps

- ★ Flood Hazard Map of India, *p276*
- ★ States Affected by Drought in India, *p314*
- ★ Drought prone Regions of India, *p315*

13.1. Subject/Theme:

Flood Hazards – Challenges and Response

PART-I

Introduction and Overview

One of the major disasters that regularly visit India is flood. The country receives an annual precipitation of 400 million hectare meters. Of these 75% is received during 4 months of monsoon, i.e., June to September. Partly natural and partly human induced floods kill more people and destroy more assets every year than hurricanes, tornadoes, windstorms or lightning. Unknown to many, flood water can be deceptively strong and harsh. Normal water moving at 6 km per hour, equivalent to a brisk walking pace, exerts a force of about 66 pounds on each square foot of anything it encounters. When this speed is doubled, the consequent force suddenly jumps to more than four times to about 264 pounds per square foot. That is substantially enough force to push a car or light truck off a flooded road when water reaches up to door level.

In India, out of the total number of 62 major rivers 18 are flood prone. About 40 million hectares out of a geographical area of 3292 lakh hectares in the country are prone to floods. Floods occur mainly

an account of heavy rainfall, tropical lows, depressions and cyclones coupled with situation of river beds, drainage congestion, and snow melt precipitated by depletion of forests. The States most affected by floods are Assam, Bihar, Uttar Pradesh, Odisha and West Bengal leading to massive crop loss and affecting about 40% of the total areas.

Other than regular floods, cloudbursts can also cause flash floods and landslides. Similarly coastal erosions also cause flood like situations, where people lose their homes, livelihood and lives. They have to be relocated temporarily/permanently, costing heavily to the economy.

While the Himalayan region is more prone to cloudbursts, the coastal States of Odisha, West Bengal, the Kutch region of Gujarat, Mumbai and South Kerala, Goa, Tamil Nadu, Andhra Pradesh and also the islands of Lakshadweep are the most vulnerable areas of coastal erosion.

The country has already put in place preparedness measures to face floods.

Objectives

Enhance participants' knowledge level about floods, their causes and characteristics, their effects and how to undertake mitigation and preparedness measures.

Methods

Presentation cum discussion, simulation exercises, mock drills

Materials/Learning Aids

Flip chart, LCD, video clips, tools and equipments for mock drills

Duration

Two sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/Knowledge related:

a) Improved knowledge on mitigation and preparedness measures, causes characteristics and effects of floods.

Skill/competency related:

a) Ability to undertake flood management activities, identify vulnerabilities and initiate preparedness measures.

Sub-themes/Key Learning Points/ Issues

- a) History of floods in India – past initiatives;
- b) Regions prone to floods, International, Inter-regional Regional Dimensions;
- c) Various types of floods;
- d) Causes and Characteristics - Flash Floods, River Floods, Coastal Floods,

river erosion, water logging;

- e) Damages caused by floods;
- f) Effects, predictability and vulnerability;
- g) Flood prevention, preparedness, mitigation and possible risk reduction measures;
- h) Typical post-disaster needs and emergency search, rescue and relief;
- i) Flood forecasting and warning system;
- j) Flood management plans;
- k) Do's and Don'ts, Guidelines; and
- l) Lessons learnt.

Activity

Mock drills on Flood warning and rescue operation during a flood

Supplementary Learning Support Material

Handout, case study, flood hazard map of India

Further Study/References

- a) **Management of floods- NDMA Guidelines, GOI, 2008**
- b) **National Water policy 2002, Ministry of Water Resources, govt. of India, New Delhi,**

- c) **India country report 1999,** (NDMA, 2008)
*Natural Disaster Management
Division, Ministry of Agriculture
Govt. of India.*
- d) **Important recommendations
of the Expert Committee** (NDMA
*Guidelines, on Management of
Floods, 2008, page-103*)
- e) *Guidelines on Management of Floods*

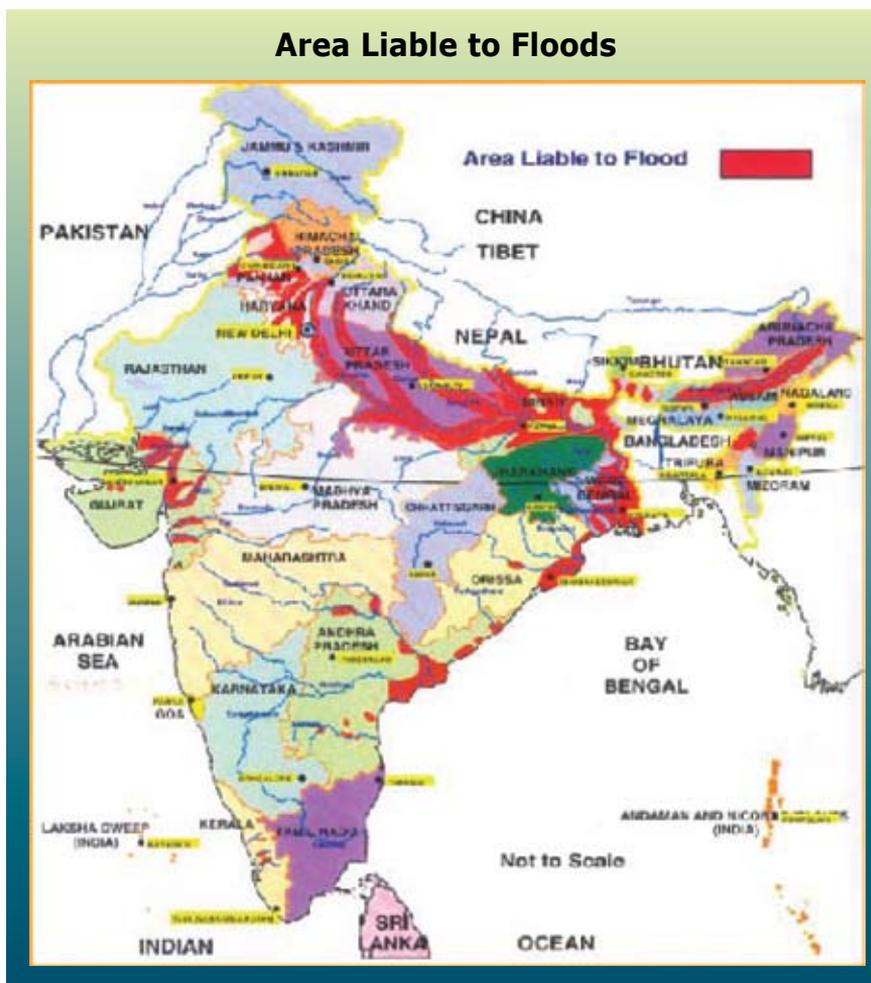
Note for the Facilitator

- a) Use the flood map of India as a reference point to stimulate discussion;
- b) Divide participants into sub groups for experience sharing; and
- c) Organise a few practice sessions.

PART-II: Supplementary Learning Support Materials

SLS - 1

Flood Hazard Map of India



SLS - 2

Handout

Floods

Definition

Water comes to the earth through rains. If the water is not managed it can create flooding. When it rushes in the upper reaches it creates flash floods. When it crosses the river embankment in plains it creates riverine floods. Likewise when the drainage system does not work well it results in water logging. Flooding occurs as a result of cyclonic weather intervention also. The problem becomes grim when human beings mismanage watersheds, drainage, basins and flood plains.

Riverine floods

Due to excessive rain at a time all the water is not discharged in the river bed and it crosses the embankment to create floods. Usually this occurs during the season either due to rain or ice melting. But this gives a warning as it builds up slowly.

Flash floods

Flash floods occur in the upper reaches of the earth where the water is not released smoothly due to obstacles enroute. This phenomena occurs due to different



reasons like cloudbursts, accelerated run off, dam failure and break up of ice jam. Flash floods do not give proper warning.

Coastal floods

Associated with tropical cyclones, tsunami waves, storm surges. Factors affecting degree of danger: depth of water, duration, velocity, rate of rise, and frequency of occurrence, seasonality.

SLS – 2A

Handout

Cloudburst

Definition

A cloudburst is sudden copious rainfall. It is a sudden aggressive rainstorm falling for a short period of time limited to a small geographical area. It is an extreme form of rainfall, sometimes mixed with hail and thunder, and is capable of creating minor flood.

They are called 'bursts' probably because it was believed earlier that clouds were solid masses full of water. These violent storms were attributed to their bursting.

Properties

Generally cloudbursts are associated with thunderstorms. The air currents rushing upwards in a rainstorm hold up a large amount of water. If these currents suddenly

cease, the entire amount of water descends on to a small area with catastrophic force all of a sudden and causes mass destruction. Cloudbursts descend from very high clouds, sometimes with tops above 15 kilometers. Meteorologists say the rain from a cloudburst is usually of the shower type with a fall rate equal to or greater than 100 mm (4.94 inches) per hour.

Rapid precipitation from cumulonimbus clouds is possible due to so called Langmuir precipitation process in which large droplets can grow rapidly by coagulating with smaller droplets which fall down slowly.

Cloudbursts in the Subcontinent

In the Indian subcontinent, a cloudburst usually occurs when a pregnant monsoon cloud drifts northwards, from the Bay of Bengal or Arabian Sea across the plains, then onto the Himalaya and bursts, bringing rainfall as high as 75 millimeters per hour.

They occur most often in desert and mountainous regions, and in interior regions of continental landmasses.

- ★ Cloudbursts frequently occur in Himachal Pradesh during the monsoon. On August 14, 2007, at least 100 people were feared washed away in flash floods caused by cloudburst at a village near Shimla, India.
- ★ In 2002 in Uttaranchal. Some 28 people died when villages like Marwari, Kotsisham, Matgoan and Agonda were hit by sudden cloudbursts.
- ★ The other parts of India have also experienced the havoc of cloudbursts.
- ★ In July 2007, close to 30,000 people were displaced in Kerala after a cloudburst & flash floods following it.
- ★ On 26 July 2005 the sudden cloudburst completely paralysed Mumbai, India's largest city and financial centre.

SLS – 2B

Handout

Coastal Erosion

Definition

Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Waves, generated by storms, wind, or fast moving motor craft, cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely the temporary redistribution of coastal sediments; erosion in one location may result in accretion nearby.

The other aspects eroding the coastline include: the sand sources and sinks, changes

in relative sea level, geomorphological characteristics of the shore and sand, etc. Other anthropological effects that trigger beach erosion are: construction of artificial structures, mining of beach sand, offshore dredging, or building of dams or rivers.

In Indian Context

Indian coastline stretches about 5700 kms on the mainland and about 7500 kms including the two island territories and exhibits most of the known geomorphological features of coastal zones. Presently, Indian coastline is facing increasing human pressures e.g., overexploitation of marine resources, dumping of industrial and toxic wastes,

oil spills and leaks which have resulted in substantial damage to its ecosystems.

The high degree of vulnerability of Indian coasts can be mainly attributed to extensive low-lying coastal area, high population density, frequent occurrence of cyclones and storms, high rate of coastal environmental degradation on account of pollution and non-sustainable development. Most of the people residing in coastal zones are directly dependent on natural resource bases of coastal ecosystems.

Land inundation and population affected

It has been suggested that the total area of 5763 km along the Coastal States of India i.e., 0.41% could be inundated and almost 7.1 million i.e., 4.6 % of coastal population could be directly affected (*TERI, 1996*). The most vulnerable areas along the Indian coastline are the Kutch region of Gujarat, Mumbai and South Kerala. Deltas of rivers Ganges (West Bengal), Cauvery (Tamil Nadu), Krishna and Godawari (Andhra Pradesh), Mahanadi (Odisha) and also the islands of Lakshadweep.

Some case studies of coastal erosion

a) Havoc of Coastal erosion in Odisha

18/09/2008, Indian Express (Bhubaneswar)

Choppy sea today nearly swallowed many villages while heavy rains battered the coastal belt amidst squally wind conditions as the deep depression over Bay of Bengal made its landfall near Chandbali. Hundreds of villagers were evacuated while thousands were marooned by the surging tidal waves in Jagatsinghpur, Kendrapara and Balasore districts. Large-scale tidal ingress wreaked havoc in the seaside villages of Mahakalpada and Rajnagar blocks of Kendrapara district and Ersama block in Jagatsinghpur district. Saline embankments caved in at several places.

b) **600-acre land in Kakinada eroded by sea**

Over 600 acres of land in the Kakinada suburbs have disappeared in the last four decades because of sea erosion. Residents of villages such as Uppada, Komaragiri, Subbam Peta and surrounding areas in the Kothapally mandal are deeply worried at the continuing erosion of the coastline. Komaragiri lost 349.29 acres of land to the sea, Uppada, 126.58 acres and Subbumpeta, 129.48 acres along with other villages. Uppada and nearby villages also suffer heavily whenever cyclones and storms occur. In the recent cyclone, tidal waves destroyed 1,200 houses including pucca buildings. It is mostly fisherfolk and small farmers who are affected by the vagaries of weather.

c) **Sagar Island erosions, West Bengal**

The island has been subjected to erosion by natural processes and to a little extent by anthropogenic activities over a long period. Major landforms identified in the coastal area of the Sagar Island are the mud flats/salt marshes, sandy beaches/dunes and mangroves. Between 1967 and 1999 about 29.8 km² of the island has been eroded. From 1996 to 1999, the erosion rate was calculated as 5.47 km²/year. The areas severely affected by erosion are the northeastern, southwestern and southeastern faces of the island.

d) **Erosion of beaches in Hulhudhoo, Meedhoo, Maldives**

24/04/2008, Haveeru Daily, Maldives

Reporters who visited the Meedhoo and Hulhudhoo islands in Addu atoll on Tuesday to see the erosion were shocked at the extent at which beach erosion had affected some regions of the beach. It was also apparent that Meedhoo was the more severe case of erosion. Three areas had been marked off in Meedhoo for the construction of breakwaters and the house-reef of the areas had cracked and broken off in many places.

Source: <http://www.indiaenvironmentportal.org.in>, Center for Science and Environment, National Knowledge Commission, GOI.

SLS – 3

Handout

Dealing with floods

Floods have been threatening the human lives and property since, perhaps, the beginning of civilisation – when settlements sprouted near the fertile river banks and deltas/coasts. However, with modern development of the past couple of centuries, the stakes in these areas have increased significantly. Today majority of the highly commercial urban centres around the world are situated in coastal areas and river deltas.

Today millions are spent worldwide on scientific research, infrastructural and community developments to minimise/prevent flood damages.

Predictability of Floods

Flood forecasting depends on seasonal patterns, capacity of drainage basin, flood plain mapping, surveys by air and land. Warning system works well in advance for seasonal floods and tsunami but only minutes before in case of storm surge, flash floods.

Factors contributing to vulnerability

- a) Location of settlements on floodplains;
- b) Lack of awareness of flooding hazard;
- c) Reduction of absorptive capacity of land (erosion, concrete);
- d) Non-resistant buildings and

foundations;

- e) High-risk infrastructural elements;
- f) Unprotected food stocks and standing crops, livestock; and
- g) Fishing boats and maritime industries.

Typical adverse affects

- a) Physical damage – Structures damaged by washing away, becoming inundated, collapsing, and impact of floating debris. Landslides from saturated soils. Damage greater in valleys than open areas;
- b) Casualties and public health – Deaths from drowning but few serious injuries;
- c) Possible outbreaks of malaria, diarrhoea and viral infections. Possible contamination of wells and groundwater. Clean water may be unavailable;
- d) Crops and food supplies - harvests and food stocks may be lost to inundation; and
- e) Animals, farm tools and seeds might be lost.

Possible risk reduction measures

- a) Land use control; and
- b) Flood control mechanism such as
 - i) Channels;
 - ii) Dikes;
 - iii) Dams;
 - iv) Flood-proofing;

- v) Erosion control;
- vi) Forestation; and
- vii) Water shed management.

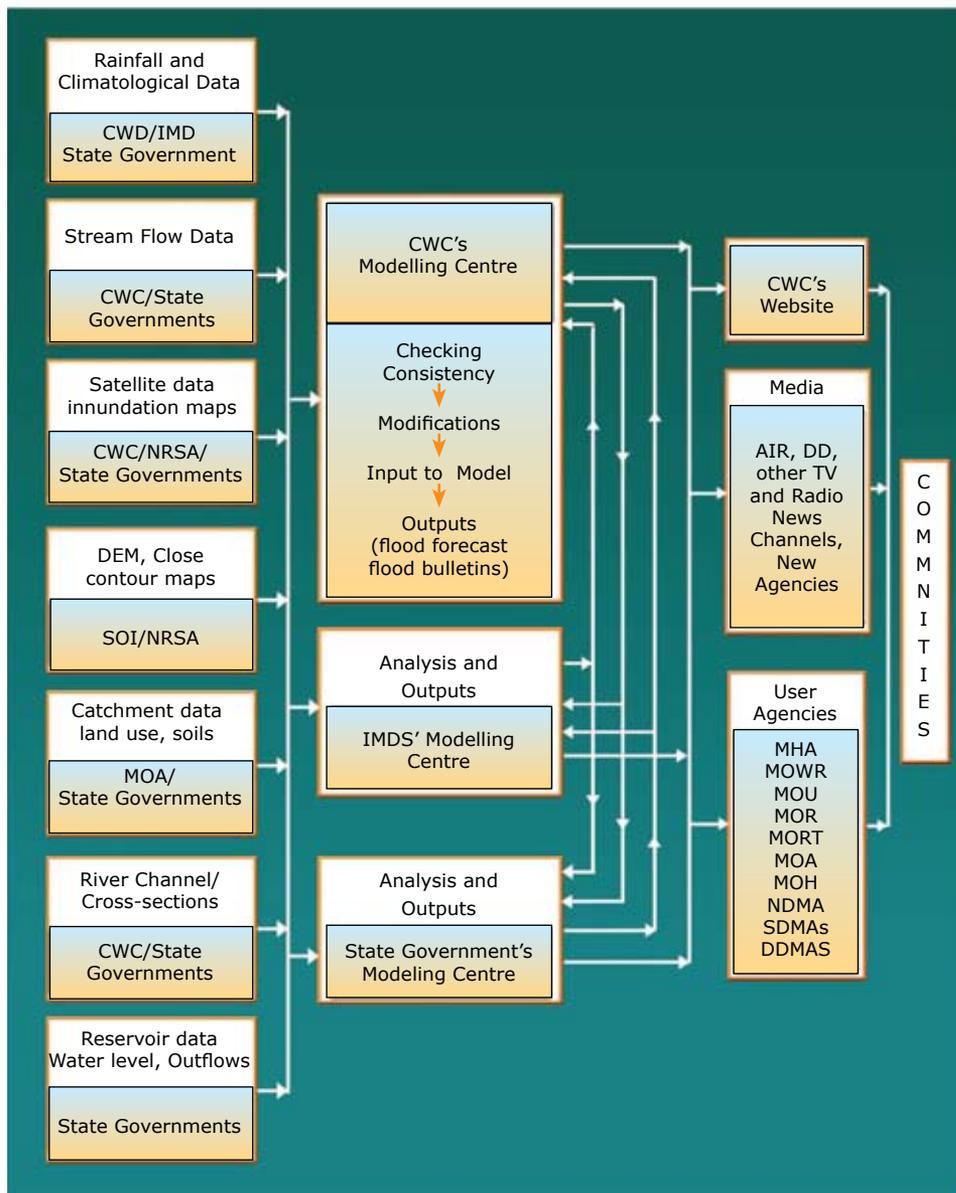
Specific preparedness measures

- a) Flood Detection And Warning Systems;
- b) Community Participation And Education;
- c) Development Of Master Plan For Floodplain Management;
- d) Search And Rescue;
- e) Medical Assistance;
- f) Disaster Assessment;
- g) Short Term Food And Water Supplies;
- h) Water Purification;
- i) Epidemiological Surveillance;
- j) Temporary Shelter;
- k) Typical Post-Disaster Needs; and
- l) Impact Assessment Tools.

SLS – 3A

Slide

Flowchart for Flood Forecasting and Early Warning



SLS – 3B

Handout

Can Dams and Levees reduce the risk of Floods?

- a) Flood-control dams have been built on many streams and rivers to store storm runoff and reduce flooding downstream.
- b) Although the same volume of water must eventually move down the river, the peak flow (the largest rate of stream flow during a flood) can be reduced by temporarily storing water and releasing it when river levels have fallen.
- c) Levees are artificial river banks built to control the spread of flood waters and to limit the amount of land covered by floods.
- d) Levees provide protection from some floods but can be over-topped or eroded away by large floods.

SLS – 3C

Handout

Report on Koshi Flood' 08 - India's Katrina

The Mississippi and the Koshi are separated by 20,000 kms of geography. But, when the mighty Koshi river flowing from Nepal to India breached its embankments in early August 2008, it was aptly referred to as India's Katrina. For nobody expected Hurricane Katrina to breach its levees that used to protect New Orleans, that too in 53 places, flooding 80% of the city, leaving trail of death and destruction.

Yet, the challenge thrown by Koshi was much bigger. The Mississippi breached the levee drowning an unsuspecting New Orleans in the USA. When the Koshi

breached and crossed its levee it was a catastrophe unlike annual floods. Like the citizens of New Orleans, people in North Bihar had also thought the levee would never breach. Yet the brimming river broke its embankment near Bhimnagar Barrage to pick up a channel it had abandoned 300 years ago, drowning 441 villages and towns and killing close to 100 people (*Unofficial report indicates loss of 3000 human lives*). About 1,65,000 hectares of land came under water, its angry torrent made relief and rescue work extremely difficult.

The initial breach was 3 km wide enlarging by about 200 meters a day. A 15 km wide current flowing at enormous speed over a stretch of 200 kms affected about 3.5 million people in 14 districts who lost their crops, land and homes and large number of domestic animals. The immediate repair work to be undertaken in Nepal could not start in the face of violent protests by the local people there.

A week after the incident, the army was called out to help in rescue and relief operations. 2000 boats and some helicopters were mobilized for this purpose, NDRF Battalions rescued thousands of marooned people. The National Disaster Management Authority (NDMA) commissioned a large number of personnel specialized in flood rescue operations that also included paramedics.

Amidst these incidents, a pregnant woman went into labour on a rescue boat coming from Kumarkhand to the relief camp. The NDRF helped her deliver a boy; the labour pain was triggered by the stress of being stranded. The rescuers faced a number of additional challenges. Restless and stranded villagers also insisted to board the boat for safety, then there were prisoners, elderly people, disabled people seeking help in addition to children and women. The patients living with leprosy found unenthusiastic rescuers. Coupled with this, there was another challenge of

providing safe and friendly shelters for this particular category of victims. Then, as people scrambled to be rescued, there was a problem of crowd management and prioritizing the rescue operation

Even some stranded villagers refused to be rescued abandoning their homes. There were reports of food riot, theft, sexual abuse, melodrama, accusation and counter accusations and of course, display of unprecedented fellow feeling, etc.

On the positive side, the calamity eliminated social and religious boundaries. There were instances of Hindus holding Iftaars for stranded Muslims and commercial sex workers feeding refugees.

The Koshi is called the river of sorrow in Bihar – an Indian State bordering Nepal. It gathers water from some of the highest mountains in the world including the Mount Everest and enters India through North Bihar and it carries over 81 million tonnes of silt every year in its rolling waters. Consequently these have given the river a braided shape forcing the water to find new ways to go further. Experts argue that building embankment allowed too much silt to deposit in a shorter stretch forcing it to flow in new directions, redefining fields, roads, and boundaries. Including the present one, the river has breached the embankments 7 times in the past. The bunds are not properly maintained. The emergency breach plugging machine

are not available. In case of the breach in Mississippi, breach plugging barriers made up driving sheet piles and geo-textile

bags weighing about 3 tonnes each were dropped by choppers to stop the water flow.

Discussion

- a) What are the similarities between Katrina and Koshi?;
- b) What are the reasons for Koshi breaching its levee?;
- c) What could have been done to prevent this disaster?;
- d) What are the possible post-disaster measures in such situation?;
- e) What kind of preparedness is needed in future?;
- f) Do you think levees are safe?;
- g) Is there any regional angle to this disaster?;
- h) What are the major lessons learnt?; and
- i) Whom would you give rescue priority from the six categories mentioned below?
 - i) restless marooned villagers clamouring for instant evacuation
 - ii) prisoners in jail surrounded by water
 - iii) A stranded woman in labour pain
 - iv) An otherwise able person unable to move on his own
 - v) Inmates of Leprosy Home
 - vi) Elderly people, women and people
 - vii) Minorities wanting to join Iftaars

After eliciting views of the trainees and summarizing the discussion, the facilitator focuses on the learning points from this calamity and sums up the discussion.

SLS – 4

Handout

Effects of Floods

Domestic Effects

- | | |
|--|--|
| <ol style="list-style-type: none"> a) The number of people affected by the current wave of flood in the State reaches to an uncountable number; | <ol style="list-style-type: none"> b) Erosion of soil continues in several places inhabited by people; c) City drainage systems fail to serve their purpose; and d) Drains carry the polluted waste water |
|--|--|

which should have actually gone to a sewerage system for treatment.

National Effects

- a) The rivers flow above the danger level;
 - b) The affected places remain cut off with the rest of the country. All the rivers rise rapidly;
 - c) Insufficient stock of food and medicine to cope with the situation is another effect;
 - d) The flood waters also damages several hutments, granaries, fisheries, standing crops;
 - e) Several roads and relief camps may also be submerged by flood water;
 - f) Landslides followed by incessant rains during floods are very common phenomena. Flood-producing rains can trigger catastrophic debris slides;
 - g) Floods can roll boulders, tear out trees, destroy buildings and bridges, and scour out new channels; and
 - h) Flood waters can reach heights of 10 to 20 feet and often carry a deadly cargo of debris.
- b) Everyone in the area should be ready to respond and act quickly. Floods and flash floods can happen quickly and without warning. Be ready to act immediately;
 - c) Be alert to signs of flooding, and if you live in a flood-prone area, be ready to evacuate at a moment's notice. Floods can happen quickly and you may need to leave with little or no notice;
 - d) Follow the instructions and advice of local authorities. Local authorities are the most informed about affected areas. They will best be able to tell you areas to avoid;
 - e) If you live in a flood-prone area or think you are at risk, evacuate immediately. Move quickly to higher ground. Save yourself, not your belongings. The most important thing is your safety;
 - f) If advised to evacuate, do so immediately. Move to a safe area before access is cut off by flood water. Evacuation is much simpler and safer before flood waters become too deep for vehicles to drive through;
 - g) Follow recommended evacuation routes. Shortcuts or alternate, non-

SLS – 5

Handout

What to do during a flood?

- a) Listen continuously to a weather radio, or a portable, battery-powered

recommended routes may be blocked or damaged by flood waters; and

- h) Leave early enough to avoid being marooned by flooded roads. Delaying too long may allow all escape routes to become blocked.

If your residence is in a flood-prone area;

- a) Fill bathtubs, sinks, and plastic bottles with clean water. Water may become contaminated or service may be interrupted;
- b) Bring outdoor belongings, such as patio furniture, indoors. Unsecured items may be swept away and damaged by flood water;
- c) Move your furniture and valuables to higher floors of your home. If flood waters affect your home, higher floors are less likely to receive damage;

- d) If you are instructed by local authorities, turn off all utilities at the main power switch and close the main gas valve. In some areas, local authorities may advise you to turn off utilities to prevent further damage to homes and the community;

- e) Get your pre-assembled disaster supplies ready. You may need to act quickly. Having your supplies ready will save time;

- f) Fill your car's gas tank, in case an evacuation notice is issued. If electric power is cut off, gas stations may not be able to operate pumps for several days; and

- g) Be prepared to evacuate. Local officials may ask you to leave if they truly feel your home is at risk from flood waters.

SLS – 6

Handout

Flood Safety

- a) Stay out of areas subject to flooding. Dips, low spots, canyons, washes, etc. can become filled with water;
- b) If outdoors, climb to high ground and stay there. Move away from dangerous flood waters; and
- c) If you come upon a flowing stream where water is above your ankles, stop, turn around, and go another way. Never try to walk, swim, or drive through such swift water. Most flood fatalities are caused by people attempting to drive through water, or people playing in high water. If it is moving swiftly, even water six inches deep can sweep you off your feet.

SLS – 7

Handout

What to do after a flood?

- a) Seek necessary medical care at the nearest hospital or clinic. Contaminated flood waters lead to a greater possibility of infection. Severe injuries will require medical attention;
- b) Help a neighbour who may require special assistance – infants, elderly people, and people with disabilities. Elderly people and people with disabilities may require additional assistance. People who care for them, or who have large families may need additional assistance in emergency situations;
- c) Avoid disaster areas. Your presence might hamper rescue and other emergency operations. It might put you at further risk from the residual effects of floods such as contaminated waters, crumbled roads, landslides, mudflows, and other hazards;

What to do after a flood? (Contd...)

- d) Continue to listen to a local radio or television stations and return home only when authorities indicate it is safe to do so. Flood dangers do not end when the water begins to recede, there may be flood-related hazards within your community, which you could hear about from local broadcasts;
- e) Stay out of any building if flood waters remain around the building. Flood waters often undermine foundations causing sinking, floors can crack or break and buildings can collapse;
- f) Avoid entering ANY building (home, business, or other) before local officials have said it is safe to do so. Buildings may have hidden damage that makes them unsafe. Gas leaks or electric or waterline damage can create additional problems; and
- g) Report broken utility lines to the appropriate authorities. Reporting potential hazards will get the utilities turned off as quickly as possible, preventing further hazard and injury check with your utility company now about where broken lines should be reported.

SLS – 8

Case Study

Urban Flooding -The Mumbai Experience

- a) Over 60% of Mumbai was inundated to various degrees on 26th July 2005;
- b) As many as 107 low-lying areas were severely flooded and the northern suburbs were severely affected;
- c) The Indian Meteorological Department (IMD) was unable to issue advance warning of this event;
- d) Even when there was heavy rainfall in the northern suburbs, the IMD was unable to monitor the rainfall and issue warnings in real time;
- e) This has been attributed to the lack of State-of-art equipment like tipping bucket rain gauges with the IMD;
- f) The immediate impact of the heavy rainfall was that there was a total collapse of the transport and communication system;
- g) Both the main Mumbai Santa Cruz airport and Juhu airport used mainly for helicopter operations had to close down for two days on 26-27th July 2006;
- h) The runways were waterlogged, the terminal buildings were flooded and crucial navigation and landing aids damaged, thus forcing 750 flights to be either diverted or cancelled;
- i) Both the major roads linking the northern suburbs to the city, namely the western expressway were submerged;
- j) Most arterial roads and highways in the suburbs were severely affected due to water logging and traffic jams resulting from breakdown vehicles in deep waters;
- k) Intercity train services had to be cancelled for over a week and suburban trains the real transport lifeline of the city failed to operate for 36 hours;
- l) A large numbers of employees and students were stranded at their respective office school and colleges;
- m) Others spent the night in the trains and buses and some even on top of buses;
- n) The mobile phone network also collapsed- the transmitters had diesel

- generators to last only 2 hours and the fuel could not be replenished;
- o) Over 2 million landline phones went out of order;
 - p) Electricity supply was disrupted resulting in the failure of sewage pumps leading to back flow of sewage in to the storm water;
 - q) Excessive rainfall led to water logging in suburban areas with water entering even first floor flats;
 - r) At least 419 peoples lost their life and 216 people died of epidemics;
 - s) 6,307 animals died;
 - t) 2000 residential buildings were fully damaged, 50,000 partially damaged and 40,000 commercial establishments suffered heavy losses; and
 - u) About 30,000 vehicles and 850 buses were damaged. Some vehicles occupants lost their lives as they couldn't open their power windows.

Discussion

After the presentation invite trainees to seek any clarification about this incident. Ask the trainees:

- a) How they would like this disaster to be handled by the authorities;
- b) How the victims are to be helped and how the situation was to be managed; and
- c) What kind of internal communication resource mobilization and coordination should be done.

After listing these questions ask the trainees to go into 3 subgroups, discuss the issue and come out with suggestion in 25 minutes. Invite each group to present its answers in the plenary.

Hold a discussion and then inform the trainees how the incident was actually handled.

How the situation was actually handled?

- a) To prevent an outbreak of epidemics 6,307 carcasses were disposed of in a priority basis by the Greater Mumbai Municipal Corporation (GMMC);
- b) 27 cranes, 87 dumpers and 24 bulldozers were put into action;
- c) Extensive spraying of disinfectants and insecticides was done to control the pest and minimize flies and mosquitoes;
- d) GMMC provided comprehensive health care services through 130 specially constituted medical teams;
- e) Over 300,000 patients were treated virtually at their door-steps through health camps and out reach camps;
- f) 253,612 metric tons of solid wastes were removed by employing 107

- bulldozers, 438 dumpers and 511 compactors;
- g) A fact finding committee was set up by the Govt. of Maharashtra to identify the cause of flood and to suggest measure for the future. The committee identified the causes as:
- i) Inadequate drainage system;
 - ii) Rapid urbanization;
 - iii) Loss of water holding ponds;
 - iv) Encroachment of the drains by the slums, etc.; and
- h) The committee recommended detail contour maps of all watersheds, stream gauging, installation of automatic rain gauges, regular maintenance of existing drains, removal of obstacles, provision of additional pumping stations and holding ponds.

13.2. Subject/Theme:

Responding to Cyclone/ Hurricane/Typhoon

PART-I

Introduction and Overview

The word **Cyclone** was originally coined in Kolkata in 1848 by a British Amateur named **Henry Piddington**, one of the earliest storm chasers. This elegant coinage was intended as a generic name for all revolving weather events but is now applied mainly to the storms of the Indian Ocean region. The terms **Hurricane & Typhoon** are regional names for a strong "tropical cyclone". Tropical cyclones are formed in 8 basins of the world, namely: **North Atlantic, North-eastern pacific, North-central pacific, North-western pacific, Northern Indian Ocean, South-western Indian Ocean, South-western Pacific, and South-eastern Indian Ocean**. Each basin has a different naming system.

Cyclones/Hurricanes/Typhoons owe their origin to tropical or sub-tropical waters and spawn winds in excess of 74 miles per hour. The most intense tropical cyclone on record till now is **Typhoon Tip** in the North-west Pacific Ocean, which, on October 12, 1979 had winds speed as high as 190 miles per hour. The Bay of Bengal

is known to be the most notorious cyclone basin. Past experience has shown that nearly four times more cyclone occurs in the Bay of Bengal than Arabian Sea causing widespread death and destruction. The latest and severe one to have visited the Bay of Bengal was the **Super Cyclone in Odisha** in 1999.

In the north Indian Ocean, cyclone seasons are May-June, mid-September to mid-December. Months of May, June, October and November are known for severe storms. At present, the cyclone surveillance in India is done by **satellite INSAT** and powerful cyclone detection **radars** installed in Kalkota, Paradeep, Bishakhapatanam, Machchillipatnam, Chennai, Karaikal, Mumbai, Goa, Cochin and Bhuj. Because of this it has been possible to issue timely warnings to the people and the authorities through cyclone warning centres located in Bhubaneswar, Kolkata, Vishakhapatnam, Chennai, Mumbai and Ahemdabad.

The main challenges are - how to prevent and minimize its effects, particularly in the most vulnerable areas, i.e., reducing damage to buildings and other infrastructures like road, railways, power supplies, water supplies, crops and food supplies, communication system and most importantly deaths due to drowning during the storm surge through early warning and preparedness.

Objectives

To promote participants' understanding of cyclone, its effects and characteristics, mitigation and risk reduction measures

Methods

Presentation cum discussion, practical, field visits to remote sensing and weather forecasting centres, mock drills

Materials/Learning aids

Flip charts, LCD, tools and equipments for rescue evacuation, etc.

Duration

Four sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/knowledge related:

- a) Participants gain full knowledge about different aspects of cyclone and the measures needed to respond to this calamity.

Competency/Skill related:

- a) Enhance ability to communicate early warning, undertake rescue of the survivors, train demonstrate and raise awareness on how to prepare and face a cyclone.

Sub themes / Key learning points / Issues

- a) History of cyclones in India;
- b) Various types of cyclones;
- c) Causes and characteristics;
- d) Cyclone vulnerability;
- e) Cyclone management - Present and future strategies;
- f) Understanding of modern cyclone forecasting system, cyclone warning, warning communication & dissemination system, and remedial measures;
- g) Cyclone mitigation measures (both structural and non-structural);
- h) Cyclone preparedness measures;
- i) Management of coastal zones - bio-shields, mangroves, shelter belt plantations, crop and livestock protection, livelihood protection, etc.
- j) Responses to cyclone - Do's and don'ts (before, during and after), medical preparedness; and
- k) Awareness generation, capacity development and handling societal impacts.

Activity

Exercises on rescue, evacuation and relief

Supplementary Learning Support

Handout on cyclone

Further study/References

World Disaster Report, 2005, Disaster and Development, NIDM, New Delhi

Note for the Facilitator

Organise mock drills, hands on experience in weather forecasting, evacuation, and other mitigation measures.



PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Lessons learnt from Odisha Super Cyclone

- a) The Community preparedness may result in a very positive public response to warning and other preparedness measures like evacuation. In case of Odisha Super Cyclone the India Meteorological Department issued very timely warning of impending Cyclone (*first warning was issued on October 26, 1999*). Despite timely warning people didn't move out of the vulnerable areas. Mass awareness programmes for the public and special training sessions for the administrative machinery to handle such type of situation must be initiated;
- b) Communication system is the major causality in case of cyclone. All means of communication like telecommunication, surface communication, radio and television transmission, etc. got affected due to this cyclone. The fallen trees on the roads blocked the roads and other means of communication like telephones went out of order. Cyclone preparedness is the only key to overcome these difficulties. Teams should be ready to clean the fallen trees and unconventional means of communication like Ham radio, satellite phone, etc. must be installed at pre-cyclone stage itself;
- c) The majority of losses due to cyclone are to the habitat. The rural houses in the coastal Odisha are non-engineered buildings. These buildings are built up with temporary materials like thatch, bamboo and mud. This type of construction is highly prone to damages in the cyclonic storms. The only way to minimize the damage is through construction of houses with permanent building materials according to the building codes;
- d) Another way to safeguard the people against cyclones is by evacuating them to the specially designed and constructed cyclone shelters. At the time of cyclone, there were twenty-three cyclone shelters in the coastal districts of Odisha. Those shelters saved thousands of lives during the cyclone. There is a need to construct more such shelters;

- e) Land use planning in coastal areas is very important and is an effective means of loss reduction. The human settlements and industries should not come very close to the coastline. The coastal belt up to 2-5 Km. from the sea must be reserved for plantation. The low-density settlements without heavy industries may be permitted at a distance of more than 5 Km. from the sea. Due to various pressures, the people have reached very near to the coastline in Odisha for settlement development and economic activities. This trend must be checked to avoid the mega disasters like this one. Mixed vegetation should be planted to act as the wind barriers to the settlements; and
- f) The physical infrastructure, which is the backbone for any post-cyclone

rescue and relief operations, is highly vulnerable to severe damages in case of cyclones. Telecommunication, power, roads, water supply, etc. were disrupted for a long period of time. Schools, health centers and other community buildings were damaged in very large numbers. These facilities take very long time in rebuilding in comparison to individual dwelling units. All these facilities must be designed and constructed as per the codes/guidelines already available for the purpose.

(Source - Fifth Training Workshop On Reconstruction And Rehabilitation Of Disaster Affected Areas, February 2003, National Centre For Disaster Management, Indian Institute Of Public Administration, New Delhi.)

SLS - 2

Handout

Tropical Cyclone

What is a Tropical Cyclone?

In general parlance a tropical cyclone is **a storm which gains tropical storm strength**. The term "tropical" refers to both the geographic origin of these systems, which form almost exclusively in tropical regions of the globe, and their formation in maritime tropical air masses. The term "cyclone" refers to such storms that are cyclonic in nature. Depending on their location and strength, tropical cyclones are referred to by other names, such as **hurricane, typhoon, tropical storm, cyclonic storm, tropical depression** and simply **cyclone**.

Characteristics of a Tropical Cyclone

- All tropical cyclones are areas of low atmospheric pressure near the Earth's surface;
- They are fueled by a **heat mechanism** different than other cyclonic windstorms;
- They develop over large bodies of warm water, and lose their strength if they move over land;
- Tropical cyclones are characterized and driven by the release of

large amounts of latent heat of condensation; and

- What primarily distinguishes tropical cyclones from other meteorological phenomena is a deep convection as driving force.

Mechanism of Tropical cyclone

The primary energy source for tropical cyclone is the release of the heat of condensation from water vapor condensing at high altitude while solar heating is the initial source for evaporation. Tropical cyclones form when the energy released by the condensation of moisture in the rising air causes a **positive feedback loop** over warm ocean waters. This positive feedback loop continues for as long as conditions are favorable for tropical cyclone development.

Factors such as a continued lack of equilibrium in air mass distribution would also give supporting energy to the cyclone. The rotation of the Earth causes the system to spin, an effect known as the **Coriolis effect** giving it a cyclonic characteristic and affecting the trajectory of the storm.

Effects

- Tropical cyclones out at sea cause large waves, heavy rain, and high winds, disrupting international shipping and, at times, causing shipwrecks;

- b) Over the past two centuries, tropical cyclones have been responsible for the deaths of about 1.9 million persons worldwide;
- c) Large areas of standing water caused by flooding lead to infection, as well as contributing to mosquito-borne illnesses;
- d) Tropical cyclones significantly interrupt infrastructure leading to power outages, bridge destruction and they hamper the reconstruction efforts; and
- e) Tropical cyclones also help maintain the global heat balance by moving warm, moist tropical air to the middle latitude and polar regions.

SLS - 3

Slide

National Cyclone Risk Mitigation Project (NCRMP)

Major Components

The National Cyclone Risk Mitigation Project (NCRMP), to be implemented with financial assistance from the World Bank, is envisaged to have four major components:

Component A: Improvement of early warning dissemination system by strengthening the Last Mile Connectivity (LMC) of cyclone warnings and advisories.

Component B: Cyclone risk mitigation investments.

Component C: Technical assistance for hazard risk management and capacity building.

Component D: Project management and institutional support.

SLS – 4

Slide

Classification of Cyclone Disturbances		
Type	Wind Speed in km/h	Wind Speed in knots
Low Pressure Area	Less than 31	Less than 17
Depression	31 – 49	17 – 27
Deep Depression	50 – 61	28 – 33
Cyclonic Storm	62 – 88	34 – 47
Severe Cyclonic Storm	89 – 118	48 – 63
Very Severe Cyclonic Storm	119 – 221	64 – 119
Super Cyclone	222 or more	120 or more

The cyclones are also classified into five different categories based on their wind speed as measured on the **Saffire Simpson Scale**.

Scale-wise (Category)	Sustained Winds in m/h	Damage	Storm Surge
1	74-95 (64-82 kt)	Minimal: Unanchored mobile homes, vegetation, signs	4-5 feet
2	96-110 (83-95 kt)	Moderate: All mobile homes, roofs, small craft, flooding	6-8 feet
3	111-130 (96-113 kt)	Extensive: Small buildings, Low lying roads cut off	9-12 feet
4	131-155 (114-135 kt)	Extreme: Roofs destroyed, trees down, roads cut off, mobile homes destroyed, beach homes flooded	13-18 feet
5	156 or more (135 kt or more)	Catastrophic: Most buildings destroyed, vegetation destroyed, Major roads cut off, Homes flooded	Greater than 18 feet

Note: Winds 39-73 mph is equivalent to 34-63 kts

(Source: IMD)

SLS – 5

Handout

Design Considerations for Buildings

- a) The design to be carried out for 1.3 times the basic wind speed as recommended in the IS 875 – 1987 part 3. The basic wind speed as per the code in most parts of the coastal zone is 50m/s (180 km/hour) up to 10 m above ground level. Further, a number of corrections are to be applied based on the importance of the structure (risk assessment), topography, size and shape of the building;
- b) The design will also be able to withstand seismic forces in regions which are additionally vulnerable to earthquake hazards, such as Kandla, etc.;
- c) The local community will be encouraged to construct houses which will be cyclone resistant. Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) will be asked to ensure this;
- d) Sloping RCC roofs (say 1 in 5 or 6 slope) will be used to provide quick rain water drainage and avoid any seepage or leakage;
- e) Minimum M30 Concrete grade (concrete having a characteristic strength of 30 N/mm²) and reinforcement steel of Fe415 grade will be used in construction. A design concrete mix as specified by IS code 456 will be adopted;
- f) An extra cover of 5 mm beyond that specified in IS:456 for the relevant exposure condition is to be provided for steel reinforcement;
- g) The materials used for construction, viz. reinforcement, aggregates and water, will be tested as per the codes provided before their use. The durability of the structure depends on the quality of the basic materials and quality assurance of the construction;
- h) The walls and all the RCC work will be plastered with cement mortar of 1:4. The basic outside plaster can be in two coats. The building will have suitable cement plaster coating both outside and inside;
- i) The doors and windows will be of aluminum with anodized fixtures. The size and thickness of the doors and windows must be of heavy gauge quality; and
- j) All inserts and fittings will be structural Aluminum.

Special Design Issues for Multipurpose Cyclone Shelters (IMPCS)

a) The cyclone shelter is primarily designed to shelter people and sometimes even cattle, during cyclones. However, it will be utilized as a multipurpose community facility all through the year so as to avoid deterioration of the building by not using it during non-cyclone periods. Therefore, the design consideration will keep in mind its use of building for various purposes such as school, ration shop, community centre, teaching centre, temporary godown or a public utility building. Constant use of the building for various purposes ensures that it is well maintained at all times and, consequently, it becomes available

during a cyclone, which is its main purpose. It also guarantees income for its maintenance;

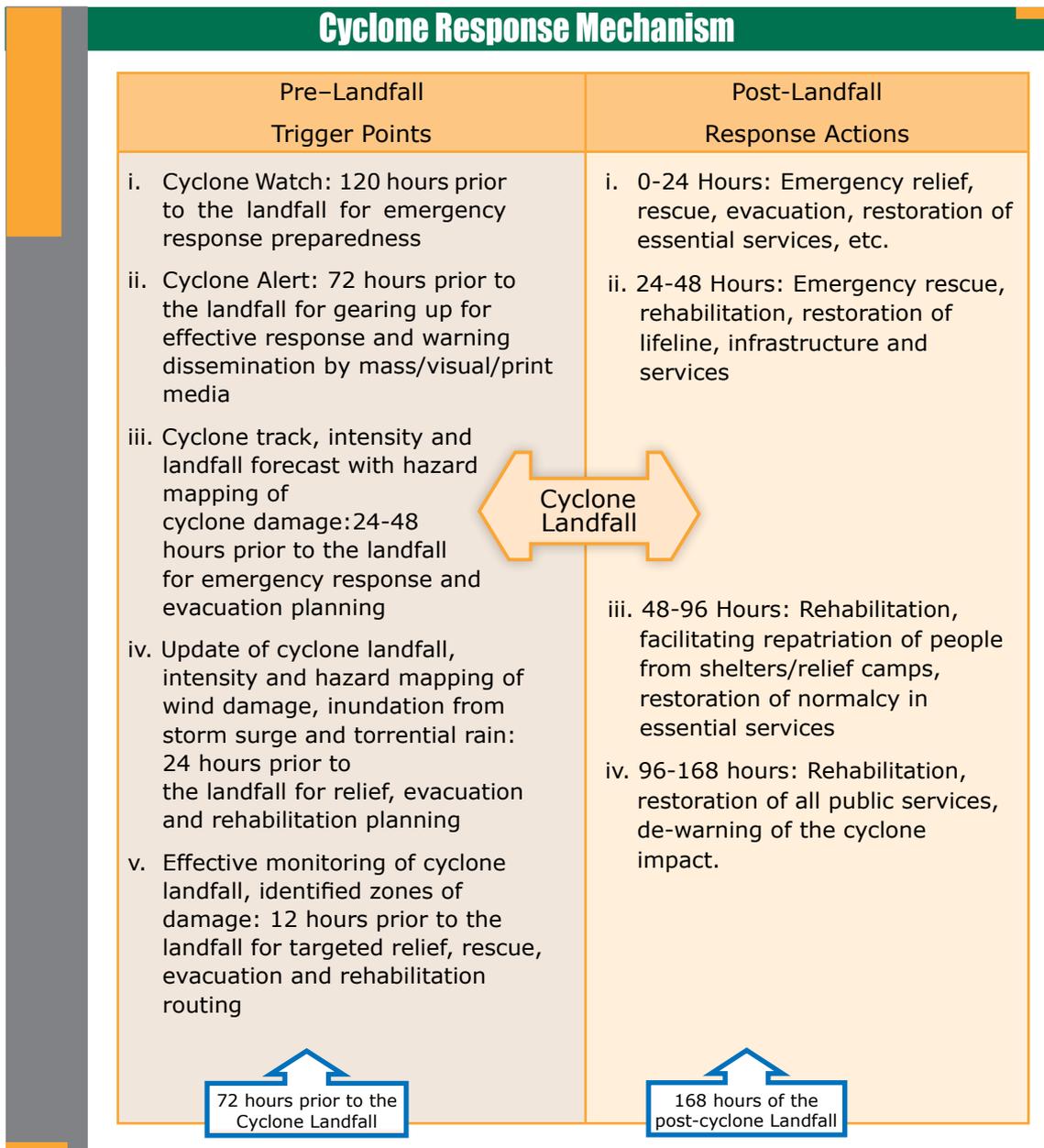
- b) Cyclone shelters will be located preferably about 1.5 km away from the coast. The shelter will be located near a school or preferably within a school premises for a cluster of villages. Alternatively, it will be located as a community facility for the cluster of villages; and
- c) The plinth height of 1.5 m will be used for stilt with the height varying from 2.5 m to 4.5 m if the storm surge level is more than 1.5 m and less than 4.5 m. In all cases, the floor level of a shelter will be at least 0.5m above the possible maximum surge level.

(Source: NDM Guidelines for Cyclone Management, 2008)

SLS - 6

Slide

Section 13



(Source: NDM Guidelines for Cyclone Management, 2008)

13.3. Subject/Theme:

Drought and Famine

PART-I

Introduction and Overview

The **non-availability** or **deficit** of **water** when required for crop watering, drinking, etc. is termed as **drought**. The irony is, this deficit could occur even during flood, when the excess flow of water is unhygienic for both consumption and utilization. In most parts of the country, majority of the people depend on monsoon and rainfall which determine crop production. It is estimated that globally, about 8 billion of people need to be fed by the end of the current century. Therefore the challenge is how to utilize land in the semi-arid and arid regions that receive irregular and erratic rainfall leading to water deficit for agriculture, human and animal consumption.

Predictably, drought is considered as a **slow moving disaster** as it has no distinct start and end. The impacts of a drought vary according to the climatic condition and the capacity of the affected groups. Consequently the perception of drought also varies. For instance in Meteorology, drought means deficit in rainfall amount, in Water Resources, it means low river flow level or reservoir storage level or decreased ground water level, In Agriculture it means deficit or no water

during critical crop-watering time, leading to poor crop-yield. In Economy it refers to profitability descent, and in Commerce it is short supply of food items. For thorough understanding of drought one requires information and assessment of aspects like temperature, rainfall, evaporation, humidity, soil moisture, vegetation cover, crop-area and type, population density, agriculture-dependant people, food storage facility, transportation network, etc.

One of the consequences of drought is **Famine, a condition of extreme and general scarcity of food**, causing distress and deaths from starvation among the population of a large area. The causes of famine are partly natural and partly artificial. Among the natural causes we may classify all failures of crops due to excess or deficit of rainfall and other meteorological phenomena, or to the ravages of insects and vermin. The artificial causes may be classified as war and economic errors in the production, transport and sale of food-stuffs, etc. Famines have caused widespread suffering in all countries and ages. The famines in India continued until independence in 1948, with the Bengal Famine of 1943-44 being among the most devastating, killing 3 to 4 million people during World War II.

Objectives

To understand causes, characteristics, consequences of drought & famine, and

possible responses to face this slow moving disaster.

Methods

Presentation cum discussion

Materials/Learning Aids

Flip chart, LCD, video clips

Duration

One session (Refer page no. 243).

Expected Learning Outcome

Cognitive/knowledge related:

- a) Improved understanding of drought and famine and ways of meeting this disaster.

Competency/Skill related:

- a) Enhanced ability to predict and assess possible drought conditions and measures to prevent and fight it.

Sub-themes/Key Learning Points/ Issues

- a) History of drought and famine in India;
- b) Drought forecasting systems in operation;
- c) Causes and consequences of drought;
- d) Skills of water harvesting , water management against drought;
- e) Education and awareness on the issue; and

- f) Organising people in the drought prone areas to fight this slow moving disaster.

Supplementary Learning Support Material

- a) Handout: Droughts in India: Some basic facts;
- b) Table on Information Requirement for drought assessment and Source;
- c) Do's and Don'ts;
- d) Slide-1 : List of Major Famines; and
- e) Drought map of India.

Activity

- a) Brainstorming on the issue, Group Work

Further Study/References

- a) National Agricultural Drought Assessment and monitoring System in India: The satellite contribution, 37th IAF Congress report, Bangalore, 1988;
- b) Global Drought watch from space, Kogan, En(1997); and
- c) FAO "Spatial information applications in early warning for food security", Hielkema, Ju(2000).

Note for the Facilitator

This is an optional session and the facilitator may conduct the session depending on profile of the participants and the areas they represent.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Droughts in India: Some basic facts

- a) India has an average annual rainfall of around 1150 mm. No other country has such a high annual average. However, there is considerable annual variation;
- b) More than 80% of rainfall is received in less than 100 days during the south-west monsoon and geographic spread is uneven;
- c) 21% area receives less than 700 mm rains annually making such areas the hot spots of drought;
- d) Inadequacy of rains coupled with adverse land-man ratio compels the farmers to practice rain-fed agriculture in large parts of the country;
- e) Irrigation, using groundwater aggravates the situation in the long run as ground-water withdrawal exceeds replenishment; in the peninsular region availability of surface water itself becomes scarce in years of rainfall insufficiency;
- f) Per capita water availability in the country is steadily declining;
- g) As against total availability 1953km, approximately 690 km of surface water and 396km of ground water resources can be put to use. So far, a quantum of about 600km has been put to use; and
- h) The traditional water harvesting systems have been largely abandoned.

SLS - 2

Slide

Information Requirement for Drought Assessment and Source

Information	Remote sensing	Ground based	Indices
Temperature	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Meteorological indices: Dryness Index, De Martonne's Index, Pluvothermic Quotient, Bhalmerly & Mooley Index, Rainfall Anomaly Index, Mean Monthly Rainfall Deficit, Rainfall Deciles, PDSI, Relative Drought Resistance
Rainfall-monthly & annual	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Evaporation		<input checked="" type="checkbox"/>	
Humidity		<input checked="" type="checkbox"/>	
Soil moisture	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Crop Moisture Index, Soil Moisture Content
Vegetation cover	<input checked="" type="checkbox"/>		Vegetation Condition Index, Soil Adjusted Vegetation Index, Stress-Related TM-based Vegetation Indices, Stress Degree Days, Crop Yield Estimation, Water Demand Analysis
Crop area & type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
River flow			Low Flow Analysis, Total surface water & ground water availability
Surface water storage area/volume	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Aquifer type		<input checked="" type="checkbox"/>	
Population		<input checked="" type="checkbox"/>	Food & Water Demand Analysis
Population density		<input checked="" type="checkbox"/>	
Human & Livestock population		<input checked="" type="checkbox"/>	

Information	Remote sensing	Ground based	Indices
Agriculture dependent people		<input checked="" type="checkbox"/>	Purchase Capacity and Target Relief
Gross income		<input checked="" type="checkbox"/>	
Food storage facility		<input checked="" type="checkbox"/>	Relief/Mitigation Camp Selection and Functioning
Medical facility		<input checked="" type="checkbox"/>	
Transportation network	<input checked="" type="checkbox"/>		
<i>(Source- Nagarajan, R, "Assessment of Drought Indicators And vulnerability," Disaster Development, vol.-1 No.-2, May 2007)</i>			

SLS - 3

Handout

Do's and Don'ts of Drought

The effect and risk of drought can be curbed at household level by taking some precautionary Do's and Don'ts measures

before, during and after the droughts. Some of such most essential, practical measures are:

Do's

- a) Tightly turn off the water tap immediately after use;
- b) Use bucket for bathing purpose;
- c) Use limited water in the kitchen;
- d) Keep/store the food grains and cattle feed in clean and dry place so that it will require little or no water for cleaning;
- e) Immediately repair the leakages in water taps or pipes in the houses or in the community, if any;
- f) Make use of traditional practices on water usage and storage prevalent in the community;
- g) If possible, construct a well inside the house premise to store rain water;
- h) Construct artificial pond in your locality to store rain water;
- i) Select such trees or crops for plantation which require minimum water to grow;
- j) Try to use the household waste water in the garden or at least grow a kitchen garden with that water;
- k) Develop better irrigation facility in the community;
- l) Take care to conserve best the available water resources around your house and village;
- m) In case of intense/severe drought situation take refuge temporarily in a better off village nearby, though it is not that easy at times;

Do's (Contd...)

- n) Participate in food-for-work programme to create rural water bodies;
- o) Sensitize and motivate your family as well as community members to save and protect water and trees;
- p) Educate yourself and the family as well as the community members on water conservation, water management and alternative farming through community participation; and
- q) The trained volunteers should create awareness among people on ways to mitigate drought effects.

Don'ts

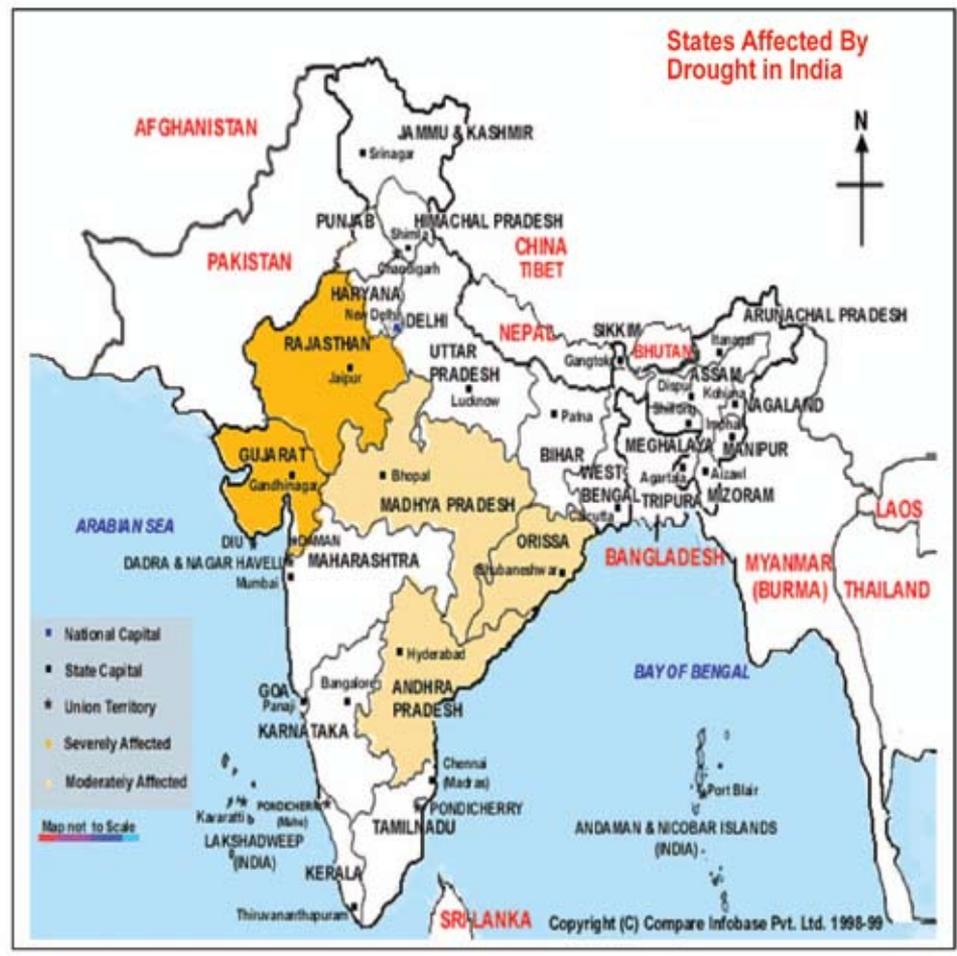
- a) Do not waste water while brushing, shaving, cleaning clothes, washing utensils or vegetables, etc.;
- b) Do not use shower while bathing as lot of water can be wasted;
- c) Do not cut trees around your house or village, try to maintain greenery;
- d) Do not change the pond area of your house or village, if any, to any land area;
- e) Do not throw away or waste any food or cattle feed; instead store them properly to be used during the drought;
- f) Do not deforest the nearby forest; and
- g) Do not cut the firewood in the drought affected areas.

SLS - 4

Map

Section 13

States affected by Drought in India



SLS - 6

Slide

List of Major Famines			
Year	Name	Location/Country	Suffered /Loss
1966	-	Bihar	More than 35 million people starved
13 Century	-	Rome	More than 1000s of starving people threw themselves in to the river Tiber in Central Italy.
1396-1407	Durga Devi	India	
1586	-	England.	
1661	-	India	
1783	-	North India (Benaras, Lahore, Jammu)	
1790-92	The Doji Bara or Skull Famine	South India (Bombay, Hyderabad, Madras)	
1838	-	North-West Provinces (United Provinces of India)	800,000 died
1866	Na'nka	Odisha, India	one million perished
1869	Intense famine	Rajputana	one and a half million perished
1874	-	Bihar, India	
1876-78	-	Bombay, Madras and Mysore	More than 5 millions perished.
1877-78	-	North China	More than Nine and a half million perished
1905	-	Bengal	
1906	-	North West India	

13.4. Subject/Theme:

Lightning and Thunder

PART-I

Introduction and Overview

Lightning - **a flash of bright light** produced by **electric discharge between the clouds** or **between clouds and the ground**, is a powerful part of earth's weather. A bolt of lightning is even hotter than sun! Lightening can strike the ground five times just in a blink! A single stroke of lightning has 1,25,000,000 volts of electricity, enough to hurt or kill someone. Each year millions of lightning flashes travel from clouds to the ground. Lightning has now been striking at alarming regularity and has emerged as a big killer in many parts of the country. On an average about 15-20 people die every day on account of this natural phenomenon. In Odisha, a coastal State in eastern India, 1706 people have perished because of lightning between 2001 and 2007.

There are also thousands of people who sustain injury in addition to loss of cattle and property. Not knowing how to protect themselves, people are mortally scared when clouds discharge electricity. Experts attribute occurrence of frequent lightning to instability in the atmosphere. As of now, flood, cyclone, drought, hailstorm, pest attack, landslide, earthquake, tsunami

and cloudburst (heavy rain) figure in the central list of natural calamities - but not heatstroke and lightning. The magnificent flash of light in the sky has become a cause of worry and panic for many. Yet, by following proper tips, training and awareness, many lives can be saved.

Objectives

To learn how lightning works, how it can be avoided, how to help people struck by lightning.

Methods

Presentation cum discussion, group work, case study

Materials/Learning Aids

LCD/OHP, Flip chart, video clips

Duration

One session (Refer page no. 243).

Expected Learning Outcome

Cognitive/knowledge related:

- a) Understanding the nature of lightning and its characteristics.

Competency/skill related:

- a) Learning what to do to avoid lightning and what to do when lightning strikes, how to react in lightning storm.

Sub-themes/Key Learning Points/ Issues

- a) What is lightning and why it occurs, how it works, how it affects;
- b) Lightning as a part of earth's weather;
- c) The damage to life and property by lightening;
- d) Warning, protection from lightening;
- e) Therapies for lightning affected people;
- f) Useful tips for safety;
- g) Local coping mechanism; and
- h) Do's and Don'ts.

Supplementary Learning Support Material

Handout containing tips on what to do for lightning safety, quiz

Activity

- a) Share experiences of some trainees;
- b) Draw some common understanding; and
- c) Organise a Quiz.

Note for the facilitator/Trainer

- a) Use handouts on lightning, thunder in organising a simulation exercise; and
- b) Use Do's and Don'ts for testing participants' understanding.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Lightning

Lightning may not seem much like static electricity, but it's actually very similar. Both are sparks of electricity created through the attraction of opposite charges. The difference is that static electricity creates a small spark, while lightning is a huge spark of electricity.

In storm clouds, tiny particles in the cloud move around picking up positive or negative energy charges, like when shoes scuff a rug. The positive charged particles stay light, and rise to the top of the cloud. The negative charged particles get heavier, and collect at the bottom of the cloud.

As more particles become charged, they divide into opposing groups in the cloud. When the power of attraction between them gets too great, the particles discharge their energy at each other, completing a path for electricity to travel through the air. We call this flow of electricity **lightning**.

It's the negative charges in the bottom of the cloud that cause lightning to strike the ground. When the negatively charged

particles group together, they begin to seek out positive charges from the ground below. The excess electrons create a channel of charged air called a **leader** that reaches down to the ground below. The leaders attract other charged ground-based channels called **streamers**.

When the stepped leader from the cloud meets a returning streamer from the ground, the path is ready. An electrical current called the **return stroke**, travels back up the path. This return stroke releases tremendous energy, bright light and thunder.

The typical stroke can last only 30 milliseconds, so four to five strokes may happen in the blink of an eye. Despite the old saying, lightning does strike the same place twice.

To review, lightning is created by the attraction between opposite charges, the same force that creates static electricity. But lightning uses huge opposite charges to produce an electrical current that's nothing like what you'd get from static electricity.

SLS - 2

Handout

Thunder

The flash of a lightning strike and resulting thunder occur at roughly the same time. But light travels at 186,000 miles in a second, almost a million times the speed of sound. Sound travels at the slower speed of one-fifth of a mile in the same time. So the flash of lightning is seen before thunder is heard. By counting the seconds between the flash and the thunder and dividing by 5, you can estimate your distance from the strike (in miles). But why does lightning cause thunder at the same time it strikes?

Lightning causes thunder because a strike of lightning is incredibly hot. A typical bolt of lightning can immediately heat the air to between 15,000 to 60,000 degrees Fahrenheit. That's hotter than the surface of the sun!

A lightning strike can heat the air in a fraction of a second. When **air is heated that quickly, it expands violently and then contracts**, like an explosion that happens in the blink of an eye. It's that explosion of air that creates sound waves, which we hear and call thunder.

When lightning strikes very close by, we hear the thunder as a loud and short bang. We hear thunder from far away as a long, low rumble.

Lightning always produces thunder. When you see lightning but don't hear any thunder, the lightning is too far away from you for the sound waves to reach you.

Light and sound will always move at different speeds. And lightning will always produce thunder because of a strike's high temperature. So no matter what, you will always see a flash of lightning before you hear thunder.

SLS - 3

Short Quiz on Lightning

A Quiz can be organised to test participants' knowledge on lightning and thunder. Some reference materials are given herewith.

How Lightning Works?

Clouds are made of numerous tiny droplets of water. When these droplets get big and heavy they fall to the earth as rain. While these drops are still in the cloud they have either a + or - charge. When a group of water **droplets with a positive charge** come near a group of **droplets with a negative charge**, a spark occurs. We see this spark as lightning.

When do you see lightning flash?

Sometimes an entire cloud (or at least the majority of the cloud) has a positive or negative charge. When two clouds of opposite charges travel near each other you can see lightning flash between the clouds.

Why lightning is dangerous?

Each year millions of lightning flashes travel from the clouds to the ground. Lightning is very powerful and very dangerous. It can cause fires, or travel through the wires of your home and destroy home appliances.

What causes lightning? How can we understand lightning by using magnets?

Lightning is caused by electricity. Although we can't see electricity, we can see its effects. Using bar magnets in an experiment is a great way to understand lightning.

What is positive and negative charge?

Each end of the magnet is marked with either a + or -. The + stands for a positive charge and the - represents the negative charge.

Place the magnets on a table and aim the + side of one magnet with the - side of the other magnet. Now let the magnets go and they will race toward each other. This is because opposite ends of the magnet (opposite charges) attract each other. Now turn the magnets around so that the positive ends are facing each other. The magnets will repel each other because like charges do not attract.

SLS - 4

Handout

Damages caused due to Lightning and Thunder

Lightning claims quite a few lives and is responsible for many injuries to humans and animals every year. Quite a large number of people get electric shock while using fixed telephones during lightning. It's because the light generated by cloud collision comes down to the earth as powerful electricity. Power of even a weak lightning is not less than 33000 KV. It strikes whatever comes on its way while coming down to earth. Once it hits the earth Lightning loses its capacity to make any further damage to life or property.

Impact

Lightning has tremendous shock and heat effect. Whatever comes on its way are affected. RCC roofs are damaged, thatched roofs and live trees are burnt; any living being that comes in contact with it is electrocuted. Even if partially hit the living being can sustain burns, get deaf and blind, and is shocked for a certain period of time or forever.

Warning

Early warning is not possible as it is not predictable.

Local knowledge

Lightning and Thunder mostly occur during pre and post monsoon rains. People normally avoid going out if there is possibility of rain. One must avoid staying in highland, under taller and lonely trees and refrain from carrying any metal.

If you hear thunder 10 seconds after a lightning flash, it is only about three kilometres away. The shorter the time, the closer the lightning. So find any shelter urgently.

Do's and Don'ts

If outside

- a) Never take shelter under a small group of trees or single tree;
- b) If far from shelter crouch preferably in a hollow;
- c) Remove metal objects from hand/body;
- d) If your hair stands or you hear buzzing from nearby rocks or fences move away immediately;
- e) At night if you see a blue glow around an object, it is about to be struck;
- f) Avoid being the highest object;
- g) Do not handle kites, fishing rods, umbrellas or metal rods;
- h) Stay away from metal poles, fences, etc.;
- i) Do not ride bicycles or travel on an open vehicle;
- j) If in water get out of it immediately;
- k) If on a boat go ashore to a shelter; and
- l) Be sure the mast and stays of the boat are secured.

Do's and Don'ts (Condt...)

If Indoors

- a) Disconnect external aerial, power leads to radio, TV, computer modems, etc.;
- b) Keep clear of windows, electrical appliances, pipes and other electric equipments; and
- c) Avoid use of fixed/land telephones.

Do's and Don'ts (Condt...)

First Aid

Please remember

- a) Apply first aid promptly. Only about 30 percent people struck by lightning die.
- b) Wet clothes prevent serious injury.
- c) Lightning may strike more than once in the same place.

Apply immediate heart massage and artificial respiration to lightning victim until medical help arrives.

13.5. Subject/Theme:

Heat Waves and Cold Waves

PART-I

Introduction and Overview

In many parts of the world, every summer and winter thousands of people fall victim to heat and cold stress and millions are affected, when their bodies can't absorb more heat or unable to withstand more cold than they can tolerate. According to the World Meteorological Organisation (WMO), 1998 was the hottest year on record creating heat waves that killed more than five thousand people in India. A **heat wave** is a **combination of high temperature and high humidity** for a prolonged period. It is a dangerous phenomenon, often fatal for lives.

The total number of people that used to die of heat waves in ten years are now dying in **just one week**. For instance, in 1998 heat waves caused 2402 deaths in Odisha alone followed by 1200 deaths in southern India. When temperature rose by nearly 10 degrees above the normal level. The WMO estimates that the number of heat related fatalities could double in less than 2 years. Elderly people, young children, the ailing & the sick and the overweight people are more vulnerable to extreme heat and cold conditions in the climate. In addition to human beings it also affects the livestock, agriculture and crop, water and

other infrastructures. In India every winter many people die of extreme cold. The worst cold wave was in January 2003 when it gripped northern central and eastern India continuously for 2 weeks and claimed over 500 lives. The worst heat wave struck Uttar Pradesh accounting for 327 deaths followed by Bihar with 90 deaths. Frigid temperature coupled with dense fog compelled authorities to cancel trains and flights, traffic on National highways moved at snails pace due to poor visibility. Rajasthan, Kashmir and Himanchal Pradesh were reeling under freezing temperatures. In January 2008, the biting chill of winter in North India even reached the western parts of the country and the plains from Kolkata to Kutch. The temperature dropped by nearly 5 degree Celsius below average at this time of the year. Scenes of people warming themselves around the fire were a common sight. Heavy snow fall converted the picturesque Dal Lake in Kashmir into a giant chunk of ice. The harsh cold killed hundred of people in different parts of the country. The worst hits were people without proper shelter and clothing. Cold and hypothermia can be just as deadly as heat strokes and lead to mass casualty. Yet, heat and cold waves can also be managed with certain preventive and curative measures.

Objectives

Understanding heat and cold waves, their impact and possible prevention/protection measures

Methods

Audio-visual presentation, discussion

Materials/Learning Aids

Flip chart, LCD/OHP, Black/white board, marker

Duration

Two sessions

Expected Learning outcome

Cognitive/knowledge related:

- a) Participants/trainees are aware of various aspects of heat and cold waves and how they affect the people

Competency/skill related:

- a) They are equipped with skills to protect themselves and other from heat as well as cold waves.

Sub-themes/ Key Learning points/ Issues

- a) History of heat and cold waves in India;
- b) Definition of heat and cold wave;
- c) Incidence and how they occur;

- d) Impact/consequences on life and property;
- e) Effects on human health, mortality;
- f) Psycho-social effects;
- g) Impact on infrastructure (power, transport, wild life);
- h) Steps for safety, emergency assistance; and
- i) Do's and Don'ts.

Supplementary Learning Support Material

- a) Handout on Heat and cold waves;
- b) Case Study on cold Wave; and
- c) Safety tips, dos and don'ts.

Further Study/References

- a) **Climate impacts, IRI climate digest**, the Earth Institute, September, 2003
- b) **More intense, more frequent and longer lasting heat waves in 21st century**, Meehl George, A Tebaldi, Claudia(2004-Science 305)

Note for the Trainer/Facilitator

Organise one simulation game on the issue

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Heat Wave and its Impact

- a) Heat wave is defined to be a prolonged period of very high summer temperatures, often combined with excessive humidity;
- b) Extreme Heat is temperatures that hover 10 degrees or more above the average high temperature of an area/ region and lasts for several weeks;
- c) Heat waves are perhaps our most underrated natural hazard;
- d) Heat stroke is life threatening and adversely affects communities;
- e) The victim's temperature control system, which produces sweating to cool the body, stops working;
- f) The body temperature can rise high enough to cause brain damage and death, if the body is not cooled quickly;
- g) Heat waves also cause expensive livestock/crop losses and damage roads, electrical equipment, railways and bridges, etc.; and
- h) Excessively dry and hot conditions can provoke dust storms and low visibility.

Heat Stress:

a) **Human Effects**

Every summer thousands of people in our country suffer from heat stress when their bodies absorb more heat than they can dispel. Unless prompt treatment is received, they suffer the serious or even fatal consequences of heat stroke (hyperthermia).

- i) At most risk are very young children; the elderly; people with weight, chronic ailments or other health problems; and those on medications or with alcohol/drug dependencies, which have a drying effect or reduce perspiration (the body's cooling system);
- ii) The death rate among older persons rises sharply during any sustained period of heat. This is especially true for those with respiratory disorders;
- iii) Men are more susceptible to heat illness as they sweat more than women and become more quickly dehydrated;
- iv) People living in urban areas

may be at a greater risk from the effects of a prolonged heat wave than people living in rural regions; and

- v) An increased health problem can occur when stagnant atmospheric conditions trap pollutants in urban areas, thus adding contaminated air to excessively hot temperatures.

b) Agriculture

Heat waves affect animals too, particularly when they are left without shade and adequate water. During heat waves, especially in times of drought, stock losses can be very high. Plants, crops and vegetables are also subject to the effects of severe heat.

c) Infrastructure

During heat waves -

- i) Railway lines can expand to the point where they buckle and cause derailments of trains; and
- ii) Road damage can also occur, with bitumen melting and concrete expanding and cracking.

d) Utilities and Services

Water and electricity consumption increases dramatically during heat waves, often causing shortages. Increased use of fans and air-conditioners causes extra demands on electricity and appliances can overheat, fail or sometimes cause fires.

SLS - 2

Slide

Section 13

Symptoms & First Aid for Heat Disorders		
Heat Disorders	Symptoms	First aid
Sunburn	Skin redness and pain, possible swelling, blisters, fever, headaches	Take a shower, using soap, to remove oils that may block pores preventing the body from cooling naturally. If blisters occur, apply dry, sterile dressings and get medical attention
Heat Cramps	Painful spasms usually in leg and abdominal muscles	Firm pressure on cramping muscles or gentle massage to relieve spasm. Give sips of water. If nausea occurs, discontinue
Heat Exhaustion	Heavy sweating, weakness, skin cold, pale and clammy. Weak pulse, possible fainting and vomiting	Get victim to lie down in a cool place. Loosen clothing. Apply cool, wet cloths. Fan or move the victim to air-conditioned place. Give sips of water. If nausea occurs, discontinue. If vomiting occurs, seek immediate medical attention.
Heat Stroke (Sun Stroke)	High body temperature (106+), dry skin, rapid/strong pulse, possible unconsciousness. Victim is not likely to sweat.	Heat stroke is a severe medical emergency. Call for emergency medical services or get the victim to a hospital immediately. Delay can be fatal. Move victim to a cooler environment. Try a cool bath or sponging to reduce body temperature. Use extreme caution. Remove clothing. Use fans and/or air conditioners. DO NOT GIVE FLUIDS.

Source: adapted from FEMA Disaster safety Tips

SLS – 3

Handout

What you should do during Extreme Heat Wave

Though heat waves can be fatal, it is easier to protect from its effects. Following preventive actions can reduce heat-related deaths:

Avoid direct sunlight if possible.

- a) Avoid doing too much on a hot day, spending too much time in the sun or staying too long in an overheated place;
- b) Wear lightweight, light-coloured, porous clothes. Dress in loose fitting clothes that cover as much skin as possible;
- c) Protect face and head by wearing a wide-brimmed head cover/hat;
- d) Use sunscreen lotion with a high SPF (sun protection factor) rating. Sunburn can significantly slow the skin's ability to release excess heat;
- e) Do not leave children (or pets) in parked vehicles. Give animals' access to shade and water. If you have a baby or children (below 4 years), pay particular attention. Consult a doctor if they appear uncomfortable;
- f) High-risk individuals should stay in cool places. Get plenty of rest to allow your natural "cooling system" to work;
- g) Avoid extreme temperature changes. A cool shower immediately after coming in from hot temperatures can result in hypothermia, particularly for elderly and very young people;
- h) If you are elderly or suffer from a chronic condition, illnesses, or just feel unwell, see a doctor immediately;
- i) Slow down. Reduce, eliminate, or reschedule strenuous activities. Drink 2- 3 liters of water per day, even if you are not thirsty;
- j) Do not consume alcohol or carbonated drinks. Although beer and alcohol beverages appear to satisfy thirst, they actually cause further body dehydration;
- k) Drink plenty of water regularly. Persons who have epilepsy or heart, kidney, or liver disease; are on fluid-restrictive diets; or have a;
- l) Avoid heavy protein foods (e.g. meat, dairy products), which raise body heat and increase fluid loss. Do not take salt tablets unless prescribed by a doctor;

- m) Check on elderly neighbors and relatives to ensure they are comfortable and coping;
- n) Allow your body to get acclimated to hot temperatures for the first 2 or 3 days of a heat wave;
- o) Keep your home cool with curtains, shutters or awnings on the sunny sides and leave windows open at night;
- p) If you don't have air-conditioning, use fans and damp towels to stay cool and have frequent cool showers. During the day spend as much time as possible in air-conditioned buildings (e.g. shopping centers, galleries, museums);
- q) Conserve electricity: During periods of extreme heat, people tend to use a lot more power for air conditioning which can lead to a power shortage or outage. Stay indoors as much as possible. If air conditioning is not available, stay on the lowest floor out of the sunshine. Remember that electric fans do not cool; they just blow hot air around;
- r) Take shelter under tree and at facilities like Schools, places of worship, libraries, etc.; and
- s) Establish temporary facilities where the effects of heat can be reduced. Conduct a two-part publicity effort,

to make the elderly aware of the location of cooling places, and to counsel against exertion in the heat.

SLS - 4

Handout

Cold Waves- Impacts and Counter Measures

A cold wave is a weather phenomenon that is distinguished by marked cooling of the air, may be accompanied by high winds that cause excessive wind chills over a large area.

Impacts of Cold Wave

- a) Exposure to extreme and especially unexpected cold can lead to hypothermia and frostbite, which require medical attention due to the hazards of tissue damage and organ failure. They can cause death and injury to livestock and wildlife. It is said that death of older people are reported more during cold waves. If a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable find grasslands and die of hypothermia or starvation;
- b) Extreme winter cold often causes poorly insulated water pipelines and mains to freeze. Even some poorly-protected indoor plumbing ruptures

- as water expands within them, causing much damage to property;
- c) Demand for electrical power and fuels rises dramatically during such times, even though the generation of electrical power may fail due to the freezing of water necessary for the generation of hydroelectricity. Some metals may become brittle at low temperatures. Motor vehicles may fail as antifreeze fails and motor oil gels, resulting even in the failure of the transportation system;
- d) Fires, paradoxically, become even more of a hazard during extreme cold. Water mains may break and water supplies may become unreliable, making firefighting more difficult. The air during a cold wave is typically denser, and any fire hazard can become intense because the colder, denser air contains more oxygen;
- e) Winter cold waves that aren't considered cold in some areas, but cause temperatures significantly below average for an area, are also destructive. Areas with subtropical climates may recognize unusual cold, perhaps barely-freezing, temperatures, as a cold wave. In such places, plant and animal life is less tolerant of such cold as may appear rarely;
- f) Abnormal cold waves that penetrate into tropical countries in which people do not customarily insulate houses or have reliable heating may cause hypothermia and even frostbite; and
- g) Cold waves that bring unexpected freezes and frosts during the growing season in mid-latitude zones can kill plants during the early and most vulnerable stages of growth, resulting in crop failure as plants are killed before they can be harvested economically. Such cold waves have caused famines. At times as deadly to plants as drought, cold waves can leave a land in danger of later brush and forest fires that consume dead biomass.

Counter Measures

- a) Most people can dress appropriately and can even layer their clothing should they need to go outside or should their heating fail. They can also stock candles, matches, flashlights, and portable fuel for cooking and wood for fireplaces or wood stoves, as necessary. However caution should be taken as the use of charcoal fires for cooking or heating within an enclosed dwelling is extremely dangerous due to carbon monoxide poisoning;

- b) In some places (like Siberia), extreme cold requires that fuel-powered machinery used even part-time must be run continuously. Internal plumbing can be wrapped, and persons can often run water continuously through pipes;
- c) Energy conservation, difficult as it is in a cold wave, may require such measures as gathering people (especially the poor and elderly) in communal shelters. Even the homeless may be arrested and taken to shelters, only to be released when the hazard abates. Hospitals can prepare for the admission of victims of frostbite and hypothermia; schools and other public buildings can be converted into shelters;
- d) Exposure to cold mandates greater caloric intake for all animals, including humans. People can stock up on food, water, and other necessities before a cold wave. Some may even choose to migrate to places of milder climates, at least during the winter. Suitable stocks of forage can be secured before cold waves for livestock, and livestock in vulnerable areas might be shipped from affected areas or even slaughtered; and
- e) Vulnerable crops may be sprayed with water that will paradoxically protect the plants by freezing and absorbing the cold from surrounding air. (The freezing of water releases heat that protects the fruit.)

Source: Source Book on District Disaster Management, Ministry of Agriculture, GOI, 2001

Section 14

Responses to Geological Disasters

Content

14.1.	Earthquakes	335
14.2.	Landslides	350
14.3.	Tsunami: Causes, Consequences, Responses	355

Supplementary Learning Support materials

Handouts

- ★ Lessons learnt from Gujarat Earthquake, *p344*
- ★ Earthquake Disaster Management Plan
-Salient Features, *p346*
- ★ Landslides in India, *p352*
- ★ Land sliding and Avalanches, *p353*
- ★ Earthquake and Tsunami, *p357*
- ★ Tsunami Characteristics, *p358*

- ★ Tsunami Signs and Warnings, *p359*
- ★ Retreat and rise cycle of the Tsunami, *p360*
- ★ Economic and Environmental Impacts on Tsunami, *p363*
- ★ Characteristics of Tsunami, *p363*
- ★ Lessons Learnt from Tsunami, *p365*

Slides

- ★ Do's and don'ts Before an Earthquake, *p340*
- ★ Do's and don'ts During an Earthquake, *p341*
- ★ Do's and don'ts After an Earthquake, *p342*
- ★ Dangerous Earthquakes, *p343*
- ★ List of Lifeline Structures requiring Structural Safety Audit, Seismic Strengthening and Retrofitting, *p348*
- ★ Critical Areas of concern for Earthquake Management, *p349*

Maps

- ★ Earthquake Zone Map of India, *p338*
- ★ Seismic Observatories of IMD, *p339*
- ★ Landslide Vulnerability Atlas of India, *p354*
- ★ Countries affected by Indian Ocean Earthquake triggered Tsunami' 2004, *p362*

Diagram

- ★ Six Pillars of Earthquake Management, *p345*

14.1. Subject/Theme:

Earthquake

PART-I

Introduction and Overview

An earthquake is a series of vibrations on the earth's surface caused by the generation of elastic (seismic) waves. The thick layer of rock known as the crust of the earth is divided in many large pieces known as **Tectonic Plates**. When two tectonic plates come in contact with each other, **they create vibrations that result in earthquakes**. The onset of earthquake is usually sudden although there are some prediction signs displayed by abnormal behaviour of birds and other animals. It was difficult to forecast the Latur earthquake of 30th September, 1993 and the Gujurat earthquake of 26th January, 2001 when the country was celebrating its republic day. The 7.8 magnitude major quake that hit southwest China's Sichuan Province in May 2008 killing 80,000 people and affecting another three million refreshes sad memories of Latur, Gujurat and Kashmir quakes.

We must face the hard fact that 30 percent of the landmass in India is prone to earthquakes of moderate intensity and 28.6 percents, of high to very high intensity. About 50 percent of the landmass is seismically active. Earthquake prone

areas are generally identified and known based on geological features and past occurrences. In addition to loss of life, earthquake causes wide spread damage to buildings, roads, electricity and water supply, communication network and other public facilities. Heavily populated areas, locations near fault lines, weak structures, poor people, children and elderly are the most vulnerable. However, the loss to life and property during earthquake can be **minimized with proper education, awareness and preventive measures**.

Objectives

To brief participants/trainees about the destructive nature of earthquake, its causes, effects and about mitigation.

Methods

Lecture-cum-discussion, question-answer, quiz, group work, demonstration

Materials/Learning Aids

Flip chart, Marker, video clipping, OHP,

Duration

Two sessions

Expected Learning outcome

Cognitive/knowledge based:

- a) Awareness about nature and characteristics of earthquake, its effects, people and areas vulnerable

to earthquake, prevention measures

Competency/skill based:

- a) Ability to undertake mitigation measures, preparedness measures and guide the people about to do (do's and don't)

Sub-themes/Key learning points/ Issues

- a) Historical background – earthquake occurrences in India;
- b) Overview of past initiatives;
- c) How it occurs and where, vulnerable zone in India, traditional housing structures in rural India, urban housing structures;
- d) Measuring earthquake effects (Richter scale);
- e) Approach and framework of earthquake management - six pillars of earthquake management;
- f) Earthquake risk mitigation measures, Institutional mechanisms;
- g) Earthquake resistant constructions, earthquake engineering, research, training;
- h) Protecting power plants, dams, bridges - retrofitting lifeline and priority structures, building codes, safety codes, structural safety audit;
- i) Awareness and preparedness;

- j) Incident Response System for effective earthquake response management - emergency search and rescue, medical response, logistics management, relief;
- k) Do's and don'ts for earthquake safety; and
- l) Lessons learnt from major earthquakes.

Supplementary Learning aids

Slides

- a) History of earthquake in India;
- b) The Richter Scale;
- c) Do's and Don'ts;
- d) Mitigation and preparedness measure; and
- e) Pictures.

Further Study/references

- a) **Management of Earthquakes**, NDMA Guidelines, GOI, 2007.
- b) **'Explanatory Handbook on Codes for Earthquake Engineering'**, SP-22 (1982) Bureau of Indian Standards, New Delhi.
- c) **'Strengthening of Brick Building Against Earthquake Forces'**, Third World Conference on Earthquake Engineering, New Zealand, Krishna, J. and Chandra, B. (1965).

- d) **'A Field Report on Structural and Geotechnical Damages Sustained during the 26th January 2001 M7.9 Bhuj Earthquake in Western INDIA'**, Jain, S. K. Murty, C.V.R., Dayal U., Arlekar, J.N. and Chaubey, S.K., (2001).

Note for the Trainers/Facilitators

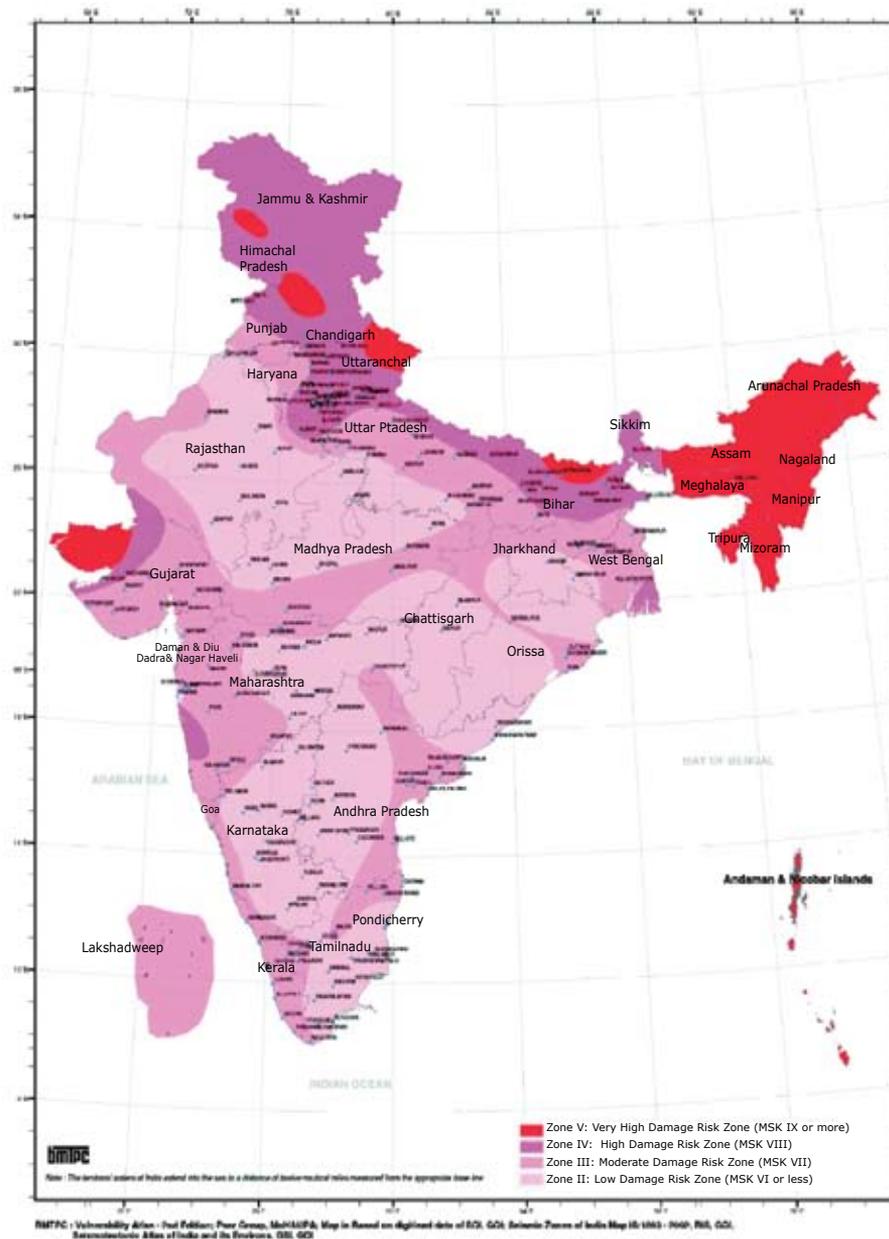
- a) This session is more a practical than thematic one;
- b) An expert having field experience should conduct the session;
- c) The participants should be made familiar with and confident of rescue techniques through demonstrations;
- d) Group work should be done in small groups;
- e) Ensure that participants can properly translate their learning in the disaster situation;
- f) Distribute the handout on animal behaviour prior to earthquake; and
- g) Distribute the note on "Dos and Don'ts" to the participants.

PART-II: Supplementary Learning Support Materials

SLS - 1

Map.

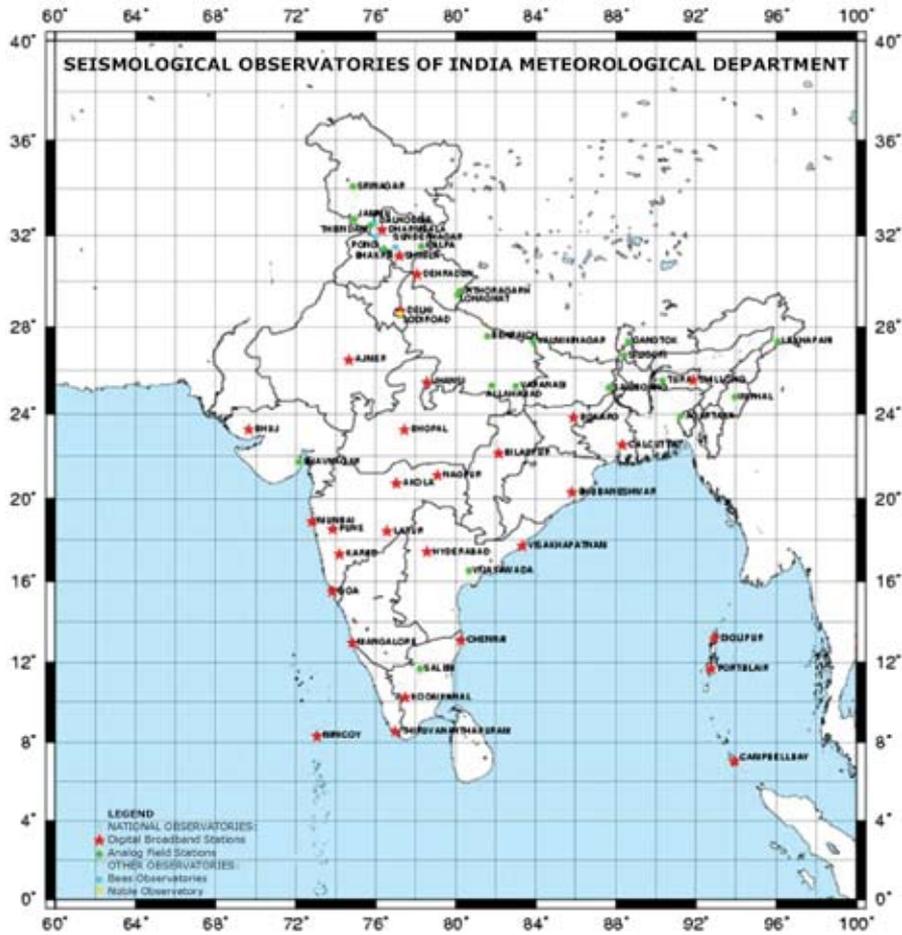
Earthquake Zone Map of India (IS 1893, 2002)



SLS - 2

Map

Seismological Observatories of IMD



SLS - 3

Do's and Don'ts for EARTHQUAKE Safety

Slide - 3A

BEFORE an Earthquake

Do's

- a) Motivate people to build earthquake resistant buildings;
- b) Repair the damaged houses;
- c) Keep emergency kit ready in the house;
- d) Do rehearsal for drop cover and hold;
- e) Disseminate awareness in the community about earthquake; and
- f) Take insurance policies.

BEFORE an Earthquake (Contd...)

Don'ts

- a) Don't stay in damaged houses;
- b) Keep vehicle away from old building that may fall; and
- c) Don't tie animals near damaged house.

Slide – 3B

DURING an Earthquake

Do's

- a) Immediately run outside in safe and open place and also carry the emergency kit;
- b) Use staircase while evacuating the place;
- c) Leave the tied animal;
- d) If it is not possible to run outside, take shelter under a bed or a table and cover your head with a pillow. (DROP COVER AND HOLD METHOD);
- e) Turn off the Gas and electricity supply;
- f) Stay away from windows, mirrors and heavy objects;
- g) On the road, drive away from subways, flyovers and bridges and stop in safe area and stay inside the vehicle; and
- h) Stay calm and keep others calm.

DURING an Earthquake (Contd...)

Don'ts

- a) Don't stay inside the house to collect money, valuables and your belongings;
- b) Do not jump out from the window without assessing the ground situation; and
- c) Do not use lift while evacuating the building.

Slide – 3C

AFTER an Earthquake

Do's

- a) Mobilise search & rescue team for trapped and missing people;
- b) Give first-aid to the injured, and refer all the emergency cases to the nearest hospital as soon as possible to save lives;
- c) Provide temporary shelters, food, drinking water to the affected people;
- d) Extra care for old people, children, infants & pregnant women;
- e) Listen to announcements on battery operated radio;
- f) Give psychosocial support to the mental trauma cases;
- g) Take care for hygiene and sanitation of the community shelters;
- h) Co-ordinate & Co-operate with local Government authorities and NGOs for relief & response;
- i) Repair main electricity & water supplies, restore communication and transportation;
- j) Repair damaged houses and build earthquake resistant house;
- k) Implementation of employment generation schemes;
- l) Distribution of livelihood kits to the affected communities; and
- m) Try to normalise the situation as soon as possible.

AFTER an Earthquake (Contd..)

Don'ts

- a) Do not spread rumours;
- b) Do not enter the damaged house;
- c) Do not stay in the damaged building; and
- d) Do not construct houses without adopting earthquake resistant codes.

Source – *Training of Trainers Hand Book for Community Based Disaster management, Indian Red Cross.*

SLS - 4

Slide

Dangerous Earthquakes

Deadliest Earthquakes				
Rank	Earthquake	Country	Year	Fatalities
1	Shaanxi	China	1556	830,000
2	Indian Ocean	nr. Indonesia	2004	283,100
3	Tangshan	China	1976	242,000
4	Aleppo	Syria	1138	230,000
5	Gansu	China	1920	200,000

a) The 2004 tsunami + earthquake is the deadliest in recorded history;

b) Prior to 2004, the deadliest recorded tsunami in the Pacific Ocean was in 1782, when 40,000 people were killed by a tsunami in the South China Sea;

c) The tsunami created by the 1883 eruption of Krakatoa is thought to have resulted in 36,000 deaths;

d) The most deadly tsunami between 1900 and 2004 occurred in 1908 in Messina, Italy on the Mediterranean Sea, where the earthquake and tsunami killed 70,000. The most deadly tsunami in the Atlantic Ocean resulted from the 1755 Lisbon earthquake, which, combined with the toll from the actual earthquake and resulting fires, killed over 100,000;

e) The 2004 earthquake and tsunami combined have been described as the deadliest natural disaster since either the 1976 Tangshan earthquake or the 1970 Bangladesh cyclone, or could conceivably exceed both of these; and

f) Because of uncertainty over death tolls, it might never be known for sure which of these natural disasters was the deadliest.

SLS - 5

Handout

Lessons learnt from Gujarat Earthquake

- a) Even the planned engineering structures built with traditional wisdom design and construction is vulnerable;
- b) The knowledge and experience gained from other earth quakes of world should be effectively utilized by the entrepreneurs, decision makers and policy planners with emphasis on recovery and reconstruction process;
- c) Besides, there must be:
 - i) Proper understanding and awareness of the risk among different State holders;
 - ii) Sufficient level of training and confidence building among the professionals; and
 - iii) Appropriate planning and mitigation strategies for useful implementation.
- d) There is a need for accurate (as much possible) damage estimation & assessment tool for emergency operation centre, preparation of multi-hazard micro-zoning maps, emergency and back-up communication system. All these

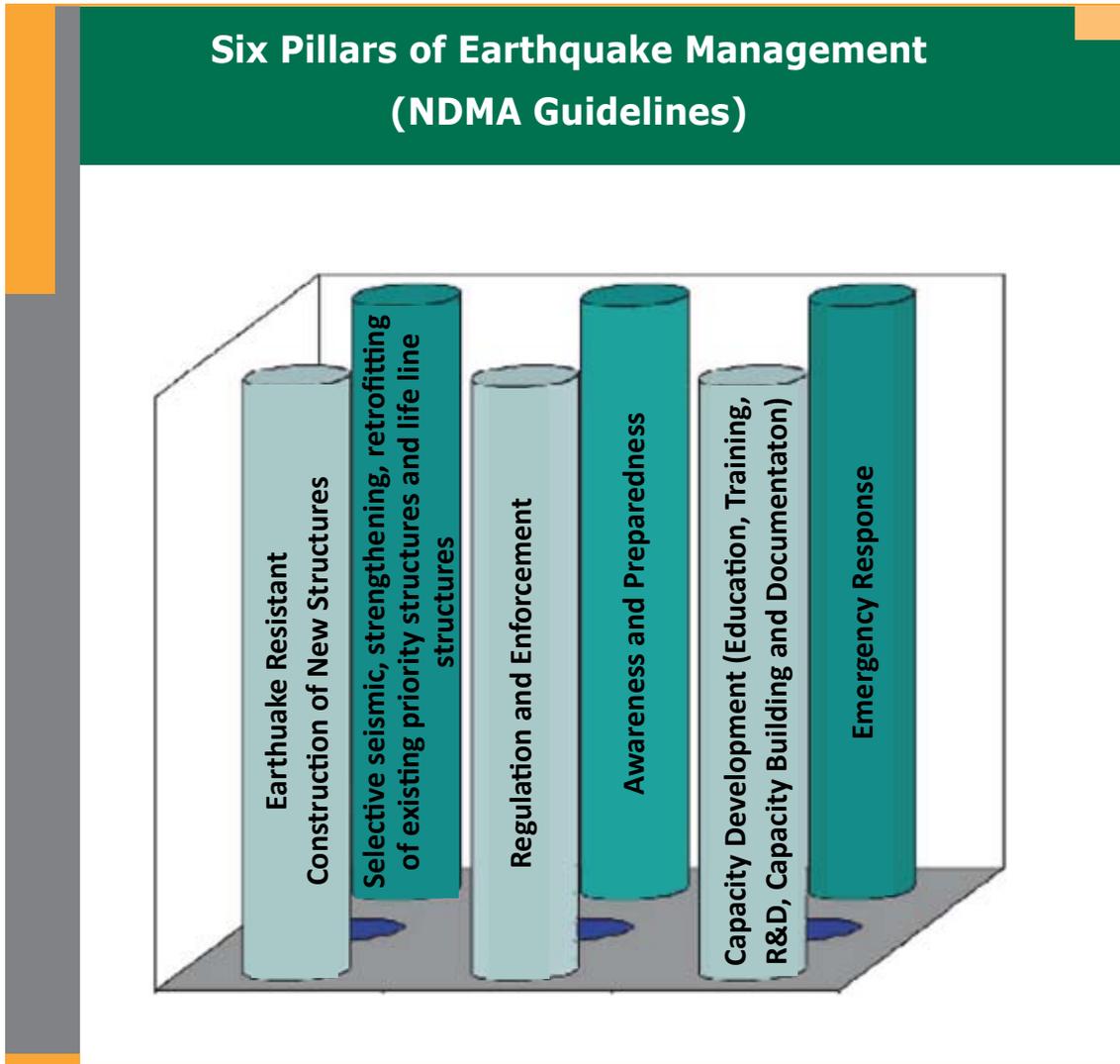
however will help in building an effective decision support system for providing effective government actions after earthquakes;

- e) Though hazard mitigation provides high social and economic dividends, the measures involved must be recognized as investment, not as luxury. Affordability and accountability must go without any question;
- f) There is an emerging need to launch a National Earthquake Mitigation program. It should have components like – a programme for retrofitting of buildings, enforcement of land use restrictions, formulation of building codes for different seismic zones and their implementation on a priority basis, and strengthening of the search and rescue capability in the country; and
- g) Last but not the least, all the Development Models must have in-built components of disaster reduction, mitigation and preparedness.

Source- Fifth Training Workshop on Reconstruction and Rehabilitation of Disaster Affected Areas February 2003, National Centre For Disaster Management, Indian Institute Of Public Administration, New Delhi.

SLS - 6

Diagram



Section 14

SLS - 7

Handout

Earthquake Disaster Management Plan - Salient Features

(NDMA Guidelines)

- a) The NDMA has identified the following salient activities of an earthquake management plan;
- b) Preparation of State and district DM plans, with specific reference to the management of earthquakes;
- c) Revision of town planning by-laws and adoption of model by-laws;
- d) Wide dissemination of earthquake-resistant building codes, the National Building Code 2005, and other safety codes;
- e) Training of trainers in professional and technical institutions;
- f) Training professionals like engineers, architects, and masons in earthquake resistant construction;
- g) Launching demonstration projects to disseminate earthquake-resistant techniques;
- h) Launching public awareness campaigns on seismic safety and risk reduction and sensitizing all stakeholders to earthquake mitigation;
- i) Establishing appropriate mechanisms for compliance review of all construction designs;
- j) Undertaking mandatory technical audits of structural designs of major projects by the respective competent authorities;
- k) Developing an inventory of the existing built environment;
- l) Assessing the seismic risk and vulnerability of the existing built environment by carrying out structural safety audits of all critical lifeline structures;
- m) Developing seismic strengthening and retrofitting standards and guidelines for existing critical lifeline structures;
- n) Undertaking seismic strengthening and retrofitting of critical lifeline structures, initially as pilot projects and then extending the exercise to the other structures in a phased manner;
- o) Preparation of DM plans by schools, hospitals, super malls, entertainment multiplexes, etc., and carrying out mock drills for enhancing preparedness;
- p) Strengthening the Emergency Operation Center (EOC) network;
- q) Streamlining the mobilization of communities, civil society partners, the corporate sector and other stakeholders;

- r) Preparing community and village level DM plans, with specific reference to management of earthquakes;
- s) Carrying out the vulnerability assessment of earthquake-prone areas and creating an inventory of resources for effective response;
- t) Introducing earthquake safety education in schools, colleges and universities and conducting mock drills in these institutions;
- u) Strengthening earthquake safety research and development in professional technical institutions
Preparing documentation on lessons from previous earthquakes and their wide dissemination;
- v) Developing an appropriate mechanism for licensing and certification of professionals in earthquake-resistant construction techniques by collaborating with professional bodies;
- w) Preparing an action plan for the upgradation of the capabilities of the IMD and BIS with clear roadmaps and milestones;
- x) Developing appropriate risk transfer instruments by collaborating with insurance companies and financial institutions;
- y) Operationalising the NDRF battalions;
- z) Operationalising the SDRF battalions in the States;
- aa) Strengthening the medical preparedness for effective earthquake response, etc.; and
- ab) Enforcement and monitoring of compliance of earthquake-resistant building codes, town planning by-laws and other safety regulations.

SLS - 8

Slide

List of Lifeline Structures requiring Structural Safety Audit, Seismic Strengthening and Retrofitting

- a) Buildings of National importance like Rashtrapati Bhavan, Parliament House, the Supreme Court of India, Raj Bhavans, Legislatures, High Courts, Central and State Secretariats, historical monuments, museums, heritage buildings, strategic assets and vital installations such as power plants and water works;
- b) Lifeline buildings, structures and critical facilities like schools, colleges and academic institutions; hospitals and health facilities, tertiary care centres and all hospitals designed as major hospital;
- c) Public utility structures like reservoirs and dams; bridges and flyovers; ports and harbours; airports, railway stations and bus station complexes;
- d) Important buildings that ensure governance and business continuity like offices like district collector and superintendent of police in districts; buildings of financial institutions like the Reserve Bank of India and stock exchanges; and
- e) Multi-storeyed buildings with five or more floors in residential apartments, office and commercial complexes.

Note:

- a) The responsibility to identify and prioritise these structures lies with respective State governments; and
- b) Additional lists of buildings and structures to be retrofitted can be prepared, after completion of the first phase of retrofitting of prioritised buildings and structures, based on the experience gained, by respective State governments.

SLS - 9

Slide

Critical Areas of concern for Earthquake Management

The critical areas of concern for the management of earthquakes in India include:

- a) Lack of awareness among various stakeholders about the seismic risk;
- b) Inadequate attention to structural mitigation measures in the engineering education syllabus;
- c) Inadequate monitoring and enforcement of earthquake-resistant building codes and town planning by-laws;
- d) Absence of systems of licensing of engineers and masons;
- e) Absence of earthquake-resistant features in non-engineered construction in suburban and rural areas;
- f) Lack of formal training among professionals in earthquake-resistant construction practices; and
- g) Lack of adequate preparedness and response capacity among various stakeholder groups.

14.2. Subject/Theme:

Landslides

PART-I

Introduction and Overview

Sliding means move along a smooth surface while remaining in contact with it and move smoothly, quickly or without being noticed (Oxford dictionary, Indian Edition). When surface soil of a vast area suddenly slips down it creates a havoc causing lot of damages to the settlements coming on their way.

It normally occurs in hilly, steep mountain areas where sub soil becomes loose due to various reasons. In India such landslides are seen in high altitude mountain ranges named as avalanche or snow sliding in higher Himalayas and land sliding in other part of the country.

Objectives

Understand nature and characteristics of landslide and frame appropriate responses to meet this disaster.

Methods

Presentation cum discussion

Materials/Learning Aids

LCD/OHP, pictures, video clips

Duration

Two sessions (Refer page no. 243).

Expected learning outcome

Cognitive/Knowledge related:

- Full knowledge about how and where it occurs, its impact and consequences.

Competency/Skill related:

- Enhance ability to identify areas vulnerable to landslide, information dissemination skills, community mobilization, rescue and evacuation measures.

Sub-themes/Learning points

- Definition of landslides;
- History of landslides in India;
- Natural signs of landslides;
- Where it occurs, vulnerable locations;
- Types of sliding and their definition;
- How it occurs;
- Its impact on population and infrastructure;
- Warning and information dissemination; and
- Do's and Don'ts.

Activity

To learn about avalanche and landslides

- Duration:** One session;
- Context:** What it mean, Definition,

Where it occurs, Types of sliding and their definition, How it occurs, Its impact, Warning possibility, Natural signs;

- c) **Methodologies:** Study of geographical condition of the country. Outside the class room on demonstration can be done on the strength of a rolling rock or sliding snow;
- d) **Teaching Aid:** Physical map of the country, Rock, snow piece, White board marker; and
- e) **Additional approach:** Discussion on some recently happened cases; Advise to collect newspaper chippings on the topic.

Supplementary learning Support Material

- a) Hand out on Land slides in India;
- b) Handout - Landslide and Avalanches; and
- c) Landslide atlas of India.

Further Study/References

The Indian Landslide Scenario:

Strategic issues and Action Points, R K Bhandari, Vol-1, No2, 2007, NIDM, New Delhi.

Note for the Trainer/Facilitator

Devote the first session on concert clarification and organise the activities in the second session.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Landslides in India

- a) In our country, there have been numerous catastrophes due to landslides, unique and unparalleled;
- b) In the recent memory, the Darjeeling floods of 1968 destroyed vast areas of Sikkim and West Bengal by unleashing some 20,000 landslides, killing thousands of people;
- c) These landslides occurred over a three-day period with precipitation ranging from 500 to 1000 mm in an event of a 100-year return period;
- d) The 60km mountain highway to Darjeeling got cut off at 92 places resulting into total disruption of the communication system;
- e) Yet another landslide tragedy of unprecedented dimension was the Alaknanda Tragedy of July 1970 that resulted from the massive floods in river Alaknanda, upon breach of a landslide dam at its confluence with river Patal Ganga;
- f) More recently, the Malpa rock avalanche tragedy, hit headlines as it instantly killed 220 people and wiped out the entire village of Malpa on the right bank of river Kali in the Kumaun Himalaya;
- g) Landslides in the southern India also revived public imagination when the recent Amboori landslide in the State of Kerala killed 23 people;
- h) In the avalanche value of the Nilgiris, majority of landslides do occur in a loose cover of debris consisting of boulders;
- i) The major landslides in the Nilgiri hills are the Runnymede landslide, the Glenmore slide, the Conoor slide and the Karadipallam slide;
- j) In the recent times, casualties and damage due to landslides have increased in the Nilgiri hills;
- k) During October-November 1978, 90 people died. The economic losses due to landslides are enormous, not to speak of strategic stakes; and
- l) In the 'Western Ghats' range also landslide occurs from time to time during monsoons. Several measures have been taken by 'Konkan Railways' to keep the railroad safe from landslides.

SLS - 2

Handout

Land sliding and Avalanches

What does it mean?

Sliding means move along a smooth surface while remaining in contact with it and move smoothly, quickly or without being noticed.

(Oxford Dictionary Indian Edition)

Definition

When surface soil of a vast area suddenly slips down it creates a havoc causing lot of damages to the settlements coming on their way.

Where it occurs

It normally occurs in hilly, steep mountain areas where sub soil becomes loose due to different reasons. In India such sliding are seen in high altitude mountain ranges naming Avalanche or snow sliding in Greater Himalayan region and land sliding in other part of the country.

Avalanche: A mass of snow and ice falling rapidly down a mountainside.

Landslide: A mass of earth or rock that slides down from a mountain or cliff.

How it occurs

Due to any reason if a substantially big land mass is detached from its origin in a high altitude location it automatically slips down crushing whatever comes on its way smashing forests, human settlements, etc.

Impact

It kills everything whatever comes in its way. It crushes, smashes and covers the human settlements, forests etc. It also disrupts the road and other communications by blocking or damaging the system. Some times unexpected flash floods occurred in non-flood areas due to this. Natural river direction can also change due to this hazard.

Warning

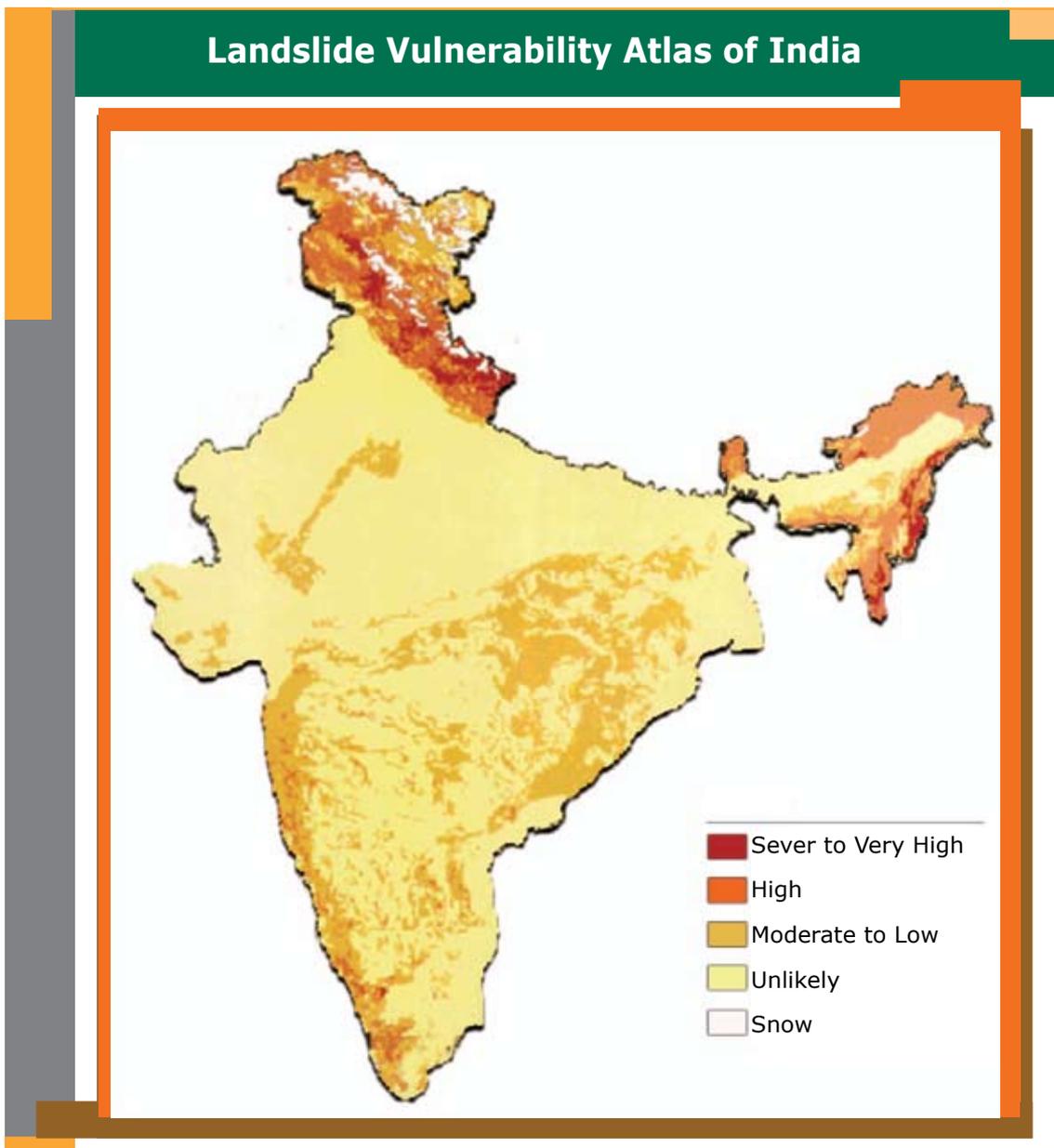
No effective warning is possible and it is not possible to predict this prior to occurrence.

Natural signs

- a) Sound in upward side; and
- b) Un-natural behaviour of birds marked from their sounds.

SLS - 3

Map



Source: Centre for Disaster Mitigation and Management, India

14.3. Subject/Theme:

Tsunami: Causes, Consequences, Responses

PART-I

Introduction and Overview

On 26th December 2004; a relatively unknown disaster called **tsunami** struck coastal India with a vengeance. It was the consequence of a **devastating earthquake** off the coast of Sumatra in the Indonesian archipelago with a magnitude of 9.0 on the Richter scale; followed by another in Great Nicobar islands in India. The result was massive tsunamis in several countries in South and South East Asia and East Africa - affecting **Indonesia, Sri Lanka, India, Bangladesh, Thailand, Somalia, Myanmar, Maldives, Malaysia, Tanzania, Kenya, and Seychelles's**.

In India, tsunami affected 2,200 kilometers of mainland and coastal line in **Tamilnadu, Kerela, Andhra Pradesh, Pondichery,** and **Andaman Nicobar** Islands. Tidal waves up to 10 Meters high penetrated up to 3 kilometers inland, taking 10,749 lives and affecting more than 2.79 million people across 1089 villages and urban locations. There was substantial loss in terms of crop and plantation loss, livelihood loss of assets. Loss of livestock, damage to fishery, pasture and grazing lands, communication infrastructure, etc.

The major challenges were to rescue people, retrieve and cremate/bury dead bodies, clear debris, transport people to relief camps, organise medical aid, arrange food, water, ensure sanitation, avoid epidemiological crisis and extend psychological care.

Objectives

To help understanding and enhance response capacity of disaster managers and volunteers on various aspects of tsunami and ways to face it.

Methods

Presentation cum discussion, group work, case study, practical sessions, mock exercises

Materials/Learning Aids

Pictures and posters, video clips, slides, LCD/OHP

Duration

Two sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/Knowledge related:

- a) An enhanced response capacity of disaster managers and volunteers on various aspects of tsunami and ways to face it

Skill/competency related:

- a) Ability to organise rescue of victims/survivors, organise medical aid, arrange food, water, ensure sanitation, avoid epidemiological crisis and extend psychological care.

Sub-themes/Key Learning points/ Issues

- a) Understanding Tsunami;
- b) Its causes, consequences, impacts on people and economy;
- c) Tsunami signs and warning;
- d) Relief and rehabilitation programme for affected people;

- e) Restoration of livelihood and ecosystems;
- f) Economic and environmental impact of Tsunami; and
- g) Building capacity to face Tsunami.

Supplementary Learning Aids

- a) Handouts on Characteristics of Tsunami
- b) Lessons learnt from Tsunami

Note for the Trainer/Facilitator

This is a relatively new subject on disaster basket. The facilitator should ensure that participants have full understanding of the subject. Resource person should be chosen with care. Video clips would help in better understanding of the subject.

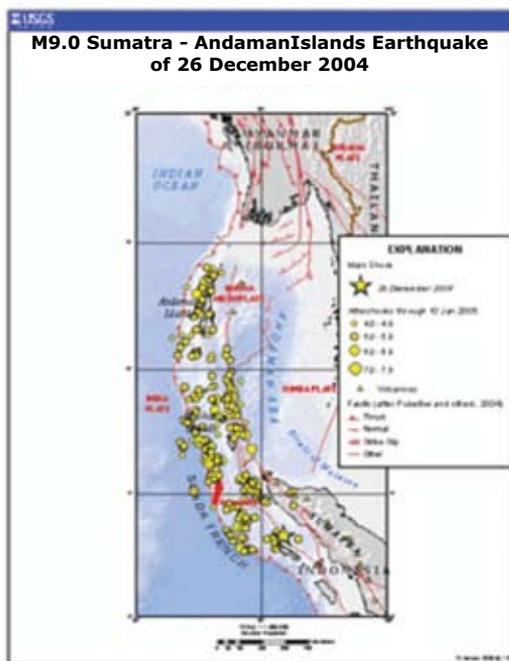
PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Earthquake and Tsunami

- a) The 2004 Indian Ocean earthquake, known by the scientific community as the **Sumatra-Andaman** earthquake, was a great undersea earthquake that occurred at 00:58:53 IST (07:58:53 local time) December 26, 2004 with an epicentre off the west coast of Sumatra, Indonesia; of Sumatra, Indonesia;



- b) The earthquake triggered a series of devastating tsunamis along the coasts of most landmasses bordering the Indian Ocean, killing large numbers of people and inundating coastal communities across South and Southeast Asia, including parts of Indonesia, Sri Lanka, India, and Thailand;
- c) Although initial estimates had put the worldwide death toll at over 275,000 with thousands of others missing, more recent analysis compiled by the United Nations lists a total of 229,866 people lost, including 186,983 dead and 42,883 missing. The figure excludes 400 to 600 people who are believed to have perished in Myanmar which is more than that government's official figure of only 61 dead;
- d) The catastrophe is one of the deadliest disasters in modern history. The disaster is known in Asia and in the international media as the Asian Tsunami, and also called the Boxing Day Tsunami in Australia, Canada, New Zealand, and the United Kingdom as it took place on Boxing Day; and

- e) Coincidentally, the tsunami occurred exactly one year after the 2003 earthquake that devastated the southern Iranian city of Bam and exactly two years before the 2006 Hengchun earthquake.

SLS - 2

Handout

Tsunami Characteristics

- a) The sudden vertical rise of the seabed by several metres during the earthquake displaced massive volumes of water, resulting in a tsunami that struck the coasts of the Indian Ocean. A tsunami which causes damage far away from its source is sometimes called a "**teletsunami**", and is much more likely to be produced by vertical motion of the seabed than by horizontal motion;
- b) The tsunami, like all others, behaved very differently in deep water than in shallow water;
- c) In deep ocean water, tsunami waves form only a small hump, barely noticeable and harmless, which generally travels at a very high speed of 500 to 1,000 km/h (310 to 620 mph); in shallow water near coastlines, a tsunami slows down to only tens of kilometres an hour but in doing so forms large destructive waves;
- d) Scientists investigating the damage in Aceh found evidence that the wave reached a height of 24 m (80 ft) when coming ashore along large stretches of the coastline, rising to 30 m (100 ft) in some areas when travelling inland;
- e) Radar satellites recorded the heights of tsunami waves in deep water two hours after the earthquake: the maximum height was 60 cm (2 ft). These are the first such observations ever made;
- f) However, these observations could not have been used to provide a warning, because the satellites were not intended for that purpose and the data took hours to analyse;
- g) According to Tad Murthy, vice-president of the Tsunami Society, the total energy of the tsunami waves was equivalent to about five megatons of TNT (20 peta-joules);
- h) This is more than twice the total explosive energy used during all of World War II (including the two atomic bombs), but still a couple of orders of magnitude less than the energy released in the earthquake itself. In many places the waves reached as far as 2 km (1.24 mi) inland;
- i) Because the 1,600 km (994 mi) of fault line affected by the earthquake was in a nearly north-south orientation, the greatest strength of

the tsunami waves was in an east-west direction. Bangladesh, which lies at the northern end of the Bay of Bengal, had very few casualties despite being a low-lying country relatively near the epicentre;

- j) It also benefited from the fact that the earthquake proceeded more slowly in the northern rupture zone, greatly reducing the energy of the water displacements in that region;
 - k) Coasts that have a landmass between them and the tsunami's location of origin are usually safe; however, tsunami waves can sometimes diffract around such landmasses; and
 - l) Thus, the Indian State of Kerala was hit by the tsunami despite being on the western coast of India, and the western coast of Sri Lanka also suffered substantial impacts. Also distance alone is no guarantee of safety; Somalia was hit harder than Bangladesh despite being much farther away.
- b) There were no tsunami warning systems in the Indian Ocean to detect tsunamis or to warn the general populace living around the ocean. However, after the Indian Ocean Tsunami the GoI has put up appropriate system in place;
 - c) Tsunami detection is not easy because while a tsunami is in deep water it has little height and a network of sensors is needed to detect it. Setting up the communications infrastructure to issue timely warnings is an even bigger problem, particularly in a relatively poor part of the world;
 - d) Tsunamis are much more frequent in the Pacific Ocean because of earthquakes in the "Ring of Fire", and an effective tsunami warning system has long been in place there;
 - e) Although the extreme western edge of the Ring of Fire extends into the Indian Ocean (the point where this earthquake struck), no warning system exists in that ocean. Tsunamis there are relatively rare despite earthquakes being relatively frequent in Indonesia;
 - f) The last major tsunami was caused by the Krakatoa eruption of 1883. It should be noted that not every earthquake produces large tsunamis; on March 28, 2005, a magnitude 8.7 earthquake hit roughly the same area of the Indian Ocean but did not result in a major tsunami;

SLS - 3

Handout

Tsunami Signs and Warnings

- a) Despite a lag of up to several hours between the earthquake and the impact of the tsunami, nearly all of the victims were taken completely by surprise;

- g) In the aftermath of the disaster, there is now an awareness of the need for a tsunami warning system for the Indian Ocean. The United Nations started working on an **Indian Ocean Tsunami Warning System** and by 2005 had the initial steps in place. Some have even proposed creating a unified global tsunami warning system, to include the Atlantic Ocean and Caribbean;
- h) The first warning sign of a possible tsunami is the earthquake itself;
- i) However, tsunamis can strike thousands of miles away where the earthquake is only felt weakly or not at all;
- j) Also, in the minutes preceding a tsunami strike, the sea often recedes **temporarily from the coast**. People in Pacific regions are more familiar



Maximum recession of tsunami waters at Kata Noi Beach, Thailand, before the third, and strongest, tsunami wave (sea visible in the right corner, the beach is at the extreme left), 10:25 a.m. local time.

with tsunamis and often recognise this phenomenon as a sign to head for higher ground.[citation needed]; and

- k) However, around the Indian Ocean, this rare sight reportedly induced people, especially children, to visit the coast to investigate and collect stranded fish on as much as 2.5 km (1.6 mi) of exposed beach, with fatal results.

SLS - 4

Handout

Retreat and rise cycle of the Tsunami

The tsunami was a succession of several waves, occurring in retreat and rise cycles with a period of over 30 minutes between each peak. The third wave was the most powerful and reached highest, occurring about an hour and a half after the first wave. Smaller tsunamis continued to occur for the rest of the day.



Second tsunami wave starting to retreat, Kata Noi Beach, Thailand 10:17 a.m.



*Receding waters after the second tsunami
10:20 a.m*



*4th tsunami wave
11:22 a.m.*

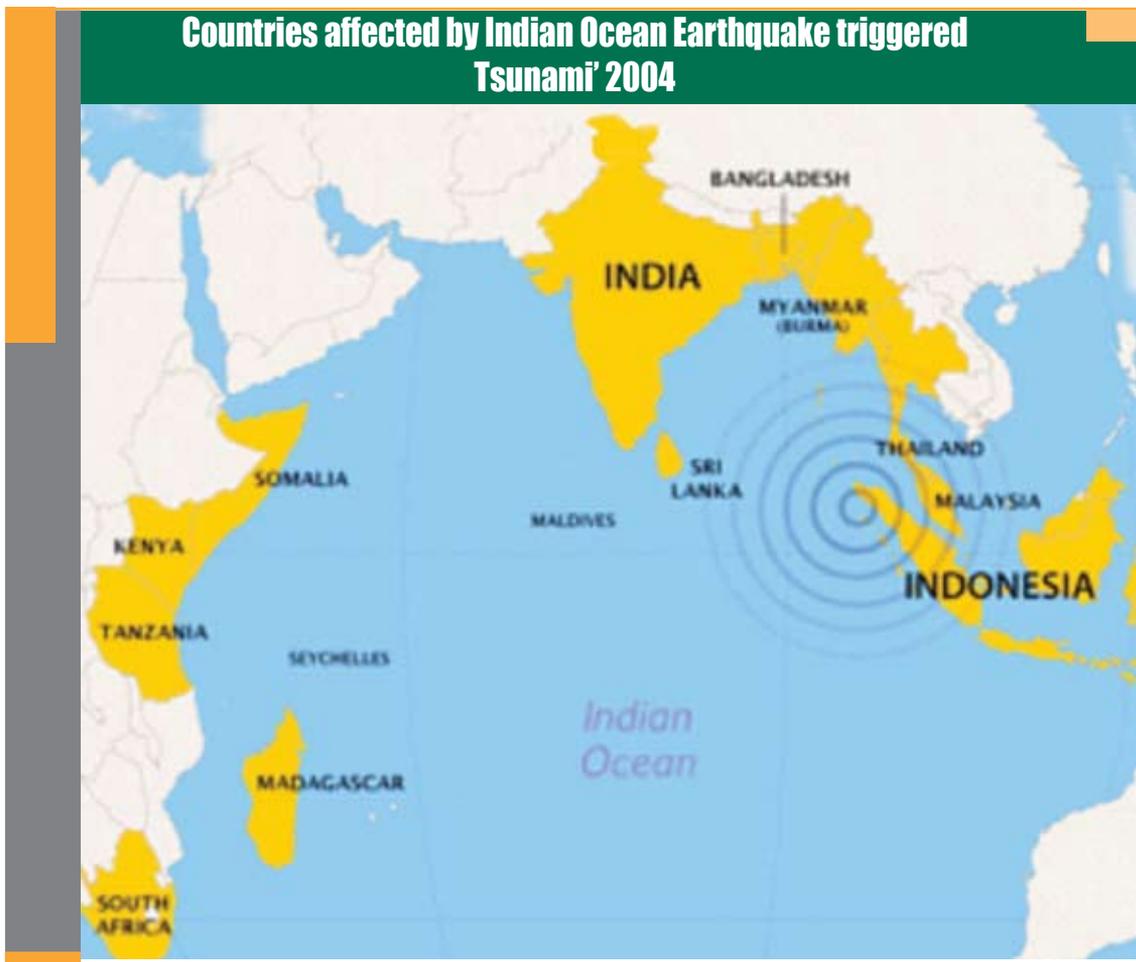


*3rd tsunami wave
11:00 a.m.*

Section 14

SLS - 5

Map



SLS - 6

Handout

Economic and Environmental Impact of Tsunami

- a) The impact on coastal fishing communities and fisher folk, some of the poorest people in the region, has been devastating with high losses of income earners as well as boats and fishing gear;
- b) In Sri Lanka artisanal fishery, where the use of fish baskets, fishing traps, and spears are commonly used, is an important source of fish for local markets; industrial fishery is the major economic activity, providing direct employment to about 250,000 people. Preliminary estimates indicate that 66% of the fishing fleet and industrial infrastructure in coastal regions have been destroyed by the wave surges, which will have adverse economic effects both at local and National levels;
- c) But some economists believe that damage to the affected National economies will be minor because losses in the tourism and fishing industries are a relatively small percentage of the GDP;
- d) However, others caution that damage to infrastructure is an overriding

factor. In some areas drinking water supplies and farm fields may have been contaminated for years by salt water from the ocean;

- e) Beyond the heavy toll on human lives, the Indian Ocean earthquake has caused an enormous environmental impact that will affect the region for many years to come;
- f) It has been reported that severe damage has been inflicted on ecosystems such as mangroves, coral reefs, forests, coastal wetlands, vegetation, sand dunes and rock formations, animal and plant biodiversity and groundwater;
- g) In addition, the spread of solid and liquid waste and industrial chemicals, water pollution and the destruction of sewage collectors; and
- h) The environmental impact will take a long time and significant resources to assess.

SLS - 7

Handout

Characteristics of Tsunami

- a) The sudden vertical rise of the seabed by several metres during the earthquake displaced massive volumes of water;
- b) A tsunami which causes damage far away from its source is sometimes

- called a "tele-tsunami", and is much more likely to be produced by vertical motion of the seabed than by horizontal motion;
- c) The tsunami, like all others, behaves very differently in deep water than in shallow water;
 - d) In deep ocean water, tsunami waves form only a small hump, barely noticeable and harmless, which generally travels at a very high speed of 500 to 1,000 km/h (310 to 620 mph); in shallow water near coastlines, a tsunami slows down to only tens of kilometres an hour but in doing so forms large destructive waves;
 - e) Coasts that have a landmass between them and the tsunami's location of origin are usually safe; however,
 - f) Rader satellites records the heights of tsunami waves in deep water;
 - g) Tsunami detection is not easy because while a tsunami is in deep water it has little height and a network of sensors is needed to detect it. Setting up the communications infrastructure to issue timely warnings is an even bigger problem, particularly in a relatively poor part of the world;
 - h) The first warning sign of a possible tsunami is the earthquake itself. However, tsunamis can strike thousands of miles away where the earthquake is only felt weakly or not at all; and
 - i) Also, in the minutes preceding a tsunami strike, the sea often recedes temporarily from the coast.

SLS – 8

Handout

Lessons learnt from Tsunami

- a) Irrespective of State Government's response SOPs need to be developed to minimise the response time.
- b) The relief teams need to be equipped with proper equipments.
- c) Need for a stronger coordination mechanism for rescue and relief especially for NGOs.
- d) Mismatch between demand and supply of relief material has to be through effective communication.
- e) Post-disaster public health problems need to be avoided through timely immunization, sanitation, and disinfection.
- f) Coastal Zone Regulation should be strictly enforced.
- g) Urgent need for early warning system

Source – Adapted from *Crisis management, From Despair to Hope, Second administration Reforms Commission Report, 2006*

Section 14

Section 15

Responses to Industrial, Chemical Disasters & Nuclear/Radiological Emergencies

Content

15.1.	Responses to Chemical & Industrial Disaster	369
15.2.	Nuclear and Radiological Emergencies: Preparedness and Response	384

Supplementary Learning Support materials

Handouts:

- ★ The Bhopal gas disaster, *p372*
- ★ Structure of Atom, *p388*
- ★ External and Internal Dose, *p391*
- ★ Protection from Radiation, *p392*
- ★ Sources of Radiation (Natural and man made), *p392*

- ★ Contamination and Decontamination, *p394*
- ★ Biological Effects of Nuclear Radiation, *p395*
- ★ Personal Protective Equipment (PPE), *397*
- ★ Nuclear and Radiological Emergency/Disaster Scenarios, *p397*
- ★ Accidents in Nuclear Power Plants and other Facilities in Nuclear Fuel Cycle, *p398*
- ★ Nuclear/Radiological Terrorism and Sabotage at Nuclear facilities, *p399*
- ★ Nuclear Weapons and their Effects, *p400*
- ★ Emergency Preparedness, *p405*
- ★ Role of First Responders, *p407*
- ★ Do's and don'ts following a Nuclear Accident Explosion, *p412*

Slides

- ★ Penetration from Ionizing Radiation, *p391*
- ★ Acute Radiation Syndrome for Gamma Radiation, *p396*
- ★ Physical Characteristics of Nuclear Explosions and their Effects, *p402*
- ★ Community Development, *p406*
- ★ Counter Measures, *p411*

Figures & Tables

- ★ The Atom, *p390*
- ★ Energy Distribution of a Fission Nuclear Device, *p403*
- ★ General Details of A-Bombings (1945) and their Effects, *p404*
- ★ Suggested Radius of Inner Cordoned area for Radiological Emergencies, *p409*
- ★ Flowchart for Response Action by the First Responder, *p410*

Case Studies

- ★ Major Nuclear Disasters, *p413*

15.1. Subject/Theme:

Responses to Chemical & Industrial Disaster

PART-I

Introduction and Overview

Chemical Disasters, though low in frequency, have the potential to cause severe short and long term damages. India is fast developing as a major economy and expanding its industrial base. A large number of multinational companies (MNCs) are also setting up industrial units here. The share of industry including construction, which was only about 14 percent in 1950s, has increased to 27 percents of the GDP, bringing home many Accident Hazard Units (AHUs). Consequently the risk of industrial and chemical disaster has also increased. This requires adequate preventive and safety mechanisms in order to protect people's health and also the environment from ill effects of industrialization. In the event of any chemical disaster, despite the safety measures, on account of human or mechanical failure, an immediate, effective medical response mechanism must be in place to handle such emergencies.

The **Bhopal gas tragedy of 1984**, the worst chemical disaster in history, witnessed mass casualties due to lack of efficient medical preparedness. In view of this there is an urgent need for

developing on-site and off-site plans near the industries along with efficient medical emergency care provisions. **The Standard Operating Procedures (SOPs)** must be rehearsed from time to time to keep the response mechanism in a State of readiness for chemical emergencies. First medical responders trained in chemical causality management protocol, detection and decontamination procedures must be available on site along with evacuation and crisis management plan.

Objectives

- a) Understanding chemical and industrial disasters, their consequences; and
- b) Capacity development and Medical preparedness for meeting chemical disasters

Expected Learning Outcome

Cognitive/Knowledge related:

- a) Complete understanding about the causes and consequences of industrial and chemical disasters and the effective response mechanism to contain it.

Competency/Skill related:

- a) Capacity to handle and manage chemical disasters through trained medical responders; and
- b) Ability to undertake risk and resource assessment, operate evacuation

plan, coordinate causality treatment, minimise toxic exposure, post-disaster care and rehabilitation.

Sub-themes/Key learning points

- a) Nature, characteristics and sources of industrial, chemical disasters- Risk of industrial and chemical disasters, causative factors - Factory and mine fires, safety and prevention mechanisms, hospital emergency response;
- b) Major chemical accidents in India;
- c) Management of chemical Accidents;
- d) Need for capacity development, training, risk and resource assessment, understanding toxicological and environmental variables;
- e) Planning for evacuation;
- f) Hospital crisis management, medical preparedness, knowing medical effects of toxic exposures;
- g) Emergency medical response;
- h) Handling chemical causality treatment kits, detection, protection and decontamination equipments;
- i) Coordination with hospitals, chemical poison centers, laboratories;
- j) Preparedness for public health and environmental challenges;
- k) Post-disaster-care and support;

- l) Skills in crisis management, awareness generation, capacity development, decision making, liaison and coordination, networking and communication;
- m) Lessons learnt from past experience; and
- n) Do's and don'ts

Methodology

Practice drills, mock rehearsals in emergencies response, group learning, and simulation exercises

Duration

Two sessions

Activity

Mock drills in emergency medial response

Additional Learning Support

- a) Handouts on the issues;
- a) Guidelines for emergency response; and
- c) Do's and Don'ts on chemical/ industrial disaster.

Further Learning

- a) ***National Disaster Management Guidelines - Chemical Disasters, NDMA, GOI' 2007***
- b) **Chemical Disaster Management: Current status and perspective,**

*Bhardwaj JR, Chawla R, Sharma RK,
JSIR, 2006*

- c) **What is a disaster?** *Assessing utility of simulated exercise and Educational process*

Note for the Trainers/Facilitators

- a) Note that this is a highly technical and practice based session;
- b) Experts with proper training skills should conduct the session; and
- c) Practical demonstration, mock-drills are to be organized to reinforce skill learning.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

The Bhopal Gas Disaster

The Bhopal disaster was an industrial disaster that occurred in the city of Bhopal, Madhya Pradesh, India, resulting in the immediate deaths of more than 3,000 people, according to the Indian Supreme Court. A more probable figure is that 8,000 died within two weeks, and it is estimated that an additional 8,000 have since died from gas related diseases.

The incident took place in the early hours of the morning of December 3, 1984, in the heart of the city of Bhopal in the Indian State of Madhya Pradesh. A Union Carbide subsidiary pesticide plant released 42 tonnes of methyl isocyanate (MIC) gas, exposing at least 520,000 people to toxic gases. The Bhopal disaster is frequently cited as the world's worst industrial disaster. The International Medical Commission on Bhopal was established in 1993 to respond to the disasters.

Background and causes, summary

The Union Carbide India, Limited (UCIL) plant was established in 1969 near Bhopal. 51% was owned by Union Carbide Corporation (UCC) and 49% by Indian authorities, although UCC was responsible

for all techniques and designs. It produced the pesticide carbaryl (trade mark Sevin). Methyl isocyanate (MIC), an intermediate in carbaryl manufacture, was also used. In 1979 a plant for producing MIC was added to the site. MIC was used instead of less toxic (but more expensive) materials, and UCC was aware of the substance's properties and how it had to be handled.

During the night of December 3rd 1984, large amounts of water entered tank 610, containing 42 tonnes of methyl isocyanate. The resulting reaction generated a major increase in the temperature inside the tank to over 200°C (400°F). The MIC holding tank then gave off a large volume of toxic gases, forcing the emergency release of pressure. The reaction was sped up by the presence of iron from corroding non-stainless steel pipelines. A mixture of poisonous gases flooded the city of Bhopal. Massive panic resulted as people woke up in a cloud of gas that burned their lungs. Thousands died from the gases and many were trampled in the panic.

Theories for how the water entered the tank differ. At the time, workers were cleaning out pipes with water, and some claim that

because of bad maintenance and leaking valves, it was possible for the water to leak into tank 610. UCC maintains that this was not possible, and that it was an act of sabotage by a "disgruntled worker" who introduced water directly into the tank. However, the company's investigation team found no evidence of the necessary connection.

The 1985 reports give a quite clear picture of what led to the disaster and how it developed, although they differ in details.

Factors leading to this mega-gas leak:

- a) The use of hazardous chemicals (MIC) instead of less dangerous ones
- b) Storing these chemicals in large tanks instead of several smaller ones
- c) Possible corroding material in pipelines
- d) Poor maintenance after the plant ceased production in the early 1980's
- e) Failure of several safety systems (due to poor maintenance and regulations)

Plant design and economic pressures to reduce expenses contributed most to the

actual leak. The problem was then made worse by the plant's location near a densely populated area, non-existent catastrophe plans, shortcomings in health care and socio-economic rehabilitation, etc. Analysis shows that the parties responsible for the magnitude of the disaster are the two owners, Union Carbide Corporation and the Government of India, and to some extent, the Government of Madhya Pradesh.

Public information

- a) Much speculation arose in the aftermath. That the Indian government closed the plant to outsiders (including UCC) and that data were not made public contributed to the confusion. The CSIR report was formally released 15 years after the disaster. The authors of the ICMR studies on health effects were forbidden to publish their data until after 1994. UCC has still not released their research about the disaster; and
- b) UCC and the Government of India maintained until 1994, when the International Medical Commission on Bhopal met, that MIC had no long term health effects.

Contributing Factors

- a) The deficiencies in the Bhopal plant design can be summarised as: choosing a dangerous method of manufacturing pesticides; large-

scale storage of MIC prior to selling; location close to a densely populated area; under-dimensioning of the safety features; dependence on manual operations; and

- b) Deficiencies in the management of UCIL can be summarised: lack of skilled operators because of the staffing policy; reduction of safety management because of reducing the staff; insufficient maintenance of the plant; lack of emergency response plans.

Plant location

A long-term cause of the catastrophe was the location of the plant; authorities had tried and failed to persuade Carbide to build the plant away from densely-populated areas. Carbide explained their refusal on the expense that such a move would incur.

Plant production process

Union Carbide produced their pesticide, Sevin (the name of carbaryl), using MIC as an intermediate. Until 1979, MIC was imported from USA. Other manufacturers, such as Bayer, made Sevin without MIC, though at greater manufacturing costs.

The Bhopal process, or "route", was to react methyl amine with phosgene (also a deadly gas and chemical warfare agent) to form MIC, the MIC was then reacted with 1-naphthol to form the final product. This

route is different to the MIC free route used elsewhere with the same raw materials in a different manufacturing order: phosgene is reacted with the naphthol first to form a chloroformate ester which is then reacted with methyl amine.

It seems as at least some of the techniques were more or less unproven. In the early 1980s, the demand for pesticides had fallen though production continued leading to buildup of stores of unused MIC.

Work conditions

Attempts to reduce expenses affected the factory's employees and their conditions.

- a) Kurzman argues that "cuts... meant less stringent quality control and thus looser safety rules. A pipe leaked? Don't replace it, employees said they were told... MIC workers needed more training? They could do with less. Promotions were halted, seriously affecting employee morale and driving some of the most skilled... elsewhere";
- b) Workers were forced to use English manuals, despite the fact that only a few had a grasp of the language;
- c) By 1984, only six of the original twelve operators were still working with MIC and the number of supervisory personnel was also cut in half. No maintenance supervisor was placed on the night shift and instrument readings were taken every two hours, rather than the previous and

- required one-hour readings;
- d) Workers made complaints about the cuts through their union but were ignored. One employee was fired after going on a 15-day hunger strike. 70% of the plant's employees were fined before the disaster for refusing to deviate from the proper safety regulations under pressure from management;
 - e) In addition, some observers, such as those writing in the Trade Environmental Database (TED) Case Studies as part of the Mandala Project from American University, have pointed to "serious communication problems and management gaps between Union Carbide and its Indian operation", characterised by "the parent companies hands-off approach to its overseas operation" and "cross-cultural barriers"; and
 - f) The personnel management policy led to an exodus of skilled personnel to better and safer jobs.
- Equipment and safety regulations**
- a) It emerged in 1998, during civil action suits in India, that, unlike Union Carbide plants in the USA, its Indian subsidiary plants were not prepared for problems. No action plans had been established to cope with incidents of this magnitude. This included not informing local authorities of the quantities or dangers of chemicals used and manufactured at Bhopal;
 - b) The MIC tank's alarms had not worked for 4 years;
 - c) There was only one manual back-up system, not the four-stage system used in the USA;
 - d) The flare tower and the vent gas scrubber had been out of service for 5 months before the disaster. The gas scrubber therefore did not treat escaping gases with sodium hydroxide (caustic soda), which may have brought the concentration down to a safe level. Even if the scrubber had been working, according to Weir, investigations in the aftermath of the disaster discovered that the maximum pressure it could handle was only one-quarter of that which was present in the accident. Furthermore, the flare tower itself was improperly designed and could only hold one-quarter of the volume of gas that was leaked in 1984;
 - e) To reduce energy costs, the refrigeration system, designed to inhibit the volatilization of MIC, had been left idle – the MIC was kept at 20 degrees Celsius, not the 4.5 degrees advised by the manual, and some of the coolant was being used elsewhere;

- f) The steam boiler, intended to clean the pipes, was out of action for unknown reasons;
- g) Slip-blind plates that would have prevented water from pipes being cleaned from leaking into the MIC tanks via faulty valves were not installed. Their installation had been omitted from the cleaning checklist;
- h) Water sprays designed to “knock down” gas leaks were poorly designed – set to 13 metres and below, they could not spray high enough to reduce the concentration of escaping gas;
- i) The MIC tank had been malfunctioning for roughly a week. Other tanks had been used for that week, rather than repairing the broken one, which was left to “stew”. The build-up in temperature and pressure is believed to have affected the explosion and its intensity;
- j) Carbon-steel valves were used at the factory, despite the fact that they corrode when exposed to acid. On the night of the disaster, a leaking carbon-steel valve was found, allowing water to enter the MIC tanks. The pipe was not repaired because it was believed it would take too much time and be too expensive;
- k) UCC admitted in their own investigation report that most of the

safety systems were not functioning on the night of the December 3, 1984; and

- l) Themistocles D'Silva contends that the design of the MIC plant, following government guidelines, was “Indianized” by UCIL engineers to maximize the use of indigenous materials and products. It also dispensed with the use of sophisticated instrumentation as not appropriate for the Indian plant. Because of the unavailability of electronic parts in India, the Indian engineers preferred pneumatic instrumentation.

Previous warnings and accidents

A series of prior warnings and MIC-related accidents had been ignored:

- a) In 1976, the two trade unions reacted because of pollution within the plant;
- b) In 1981, a worker was splashed with phosgene. In panic he ripped off his mask, thus inhaling a large amount of phosgene gas; he died 72 hours later;
- c) In January 1982, there was a phosgene leak, when 24 workers were exposed and had to be admitted to hospital. None of the workers had been ordered to wear protective masks;
- d) In February 1982, an MIC leak affected 18 workers;

- e) In August 1982, a chemical engineer came into contact with liquid MIC, resulting in burns over 30 percent of his body;
 - f) In October 1982, there was a leak of MIC, methylcarbaryl chloride, chloroform and hydrochloric acid. In attempting to stop the leak, the MIC supervisor suffered intensive chemical burns and two other workers were severely exposed to the gases;
 - g) During 1983 and 1984, leaks of the following substances regularly took place in the MIC plant: MIC, chlorine, monomethylamine, phosgene, and carbon tetrachloride, sometimes in combination;
 - h) Reports issued months before the incident by scientists within the Union Carbide corporation warned of the possibility of an accident almost identical to that which occurred in Bhopal. The reports were ignored and never reached senior staff; and
 - i) Union Carbide was warned by American experts who visited the plant after 1981 of the potential of a "runaway reaction" in the MIC storage tank; local Indian authorities warned the company of problems on several occasions from 1979 onwards. Again, these warnings were not heeded.
- b) During the nights of 2-3 December, large amounts of water entered tank 610. A run-away reaction started, which was accelerated by contaminants, high temperatures and other factors. The reaction generated a major increase in the temperature of liquid inside the tank to over 200°C (400°F). The MIC holding tank then gave off a large volume of toxic gases, forcing the emergency release of pressure. The reaction was sped up by the presence of iron from corroding non-stainless steel pipelines;
 - c) We know that workers cleaned pipelines with water. They were not told by the supervisor to add a slip-blind water isolation plate. Because of this, and of the bad maintenance, the workers consider it possible for water to enter the MIC tank;
 - d) UCC maintains that a "disgruntled worker" deliberately connected a hose to a pressure gauge. However, this would hardly have been possible if the safety rules had been followed; and
 - e) UCC's investigation team found no evidence of the suggested connection.

The leakage

- a) In November 1984, most of the

Time line of the Tragedy

At the plant

- a) 21.00 Water cleaning of pipes starts.
- b) 22.00 Water enters 610. Reaction starts.
- c) 22.30 Gases are emitted from the VGS-tower.
- d) 00.30 The large siren sounds and is turned off.
- e) 00.50 The siren is heard within the plant area. The workers escape.

Time line of the Tragedy (Contd...)

Outside

- a) 22.30 First sensations felt. Suffocation, cough, burning eyes, vomiting.
- b) Police are alerted. Residents evacuate. UC-director denies a possible leak.
- c) 2.00 The first people reached Hamidia hospital. Symptoms include visual impairment and blindness, respiratory difficulties, frothing at the mouth, and vomiting.
- d) 2.10 The alarm is heard outside the plant.
- e) 4.00 The gases are brought under control.
- f) 6.00 The police's loudspeaker says: "Everything is normal".

Health effects

Short term health effects

- a) Apart from MIC the gas cloud may have contained phosgene, hydrogen cyanide, carbon monoxide, hydrogen chloride, nitrous oxides, monomethyl amine (MMA) and carbon dioxide, either produced in the storage tank

or in the atmosphere. All these gases, except carbon dioxide, are acutely toxic at levels well below 500 ppm;

- b) The gas cloud, composed mainly of materials more dense than the surrounding air, stayed close to the ground and spread outwards through the surrounding community. The

initial effects of gas exposure were coughing, vomiting, severe eye irritation and a feeling of suffocation. People awoken by these symptoms fled away from the plant. Those who ran inhaled more than those who had a vehicle. Due to their height, children and other people of lower stature inhaled relatively higher concentrations. Many people were trampled trying to escape;

- c) Thousands of people had succumbed to gas exposure by the morning hours. There were mass funerals and mass cremations as well as bodies being disposed of in the Narmada river. 170,000 people were treated at hospitals and temporary dispensaries. 2,000 buffaloes, goats, and other animals had to be collected and buried. Within a few days, leaves on trees went yellow and fell off. Supplies including food became scarce due to safety fears by the suppliers. Fishing was prohibited as well which caused further supply shortages;
- d) A total of 36 wards were marked by the authorities as being "gas

affected", affecting a population of 520,000. Of these, 200,000 were below 15 years of age, and 3,000 were pregnant women. In 1991, 3,928 deaths had been certified. Independent organizations recorded 8,000 dead the first days. Other estimations vary between 10,000 and 20,000. It is estimated that 10,000 have died since the accident from gas related diseases. Another 100,000 to 200,000 people are estimated to have permanent injuries; and

- e) The acute symptoms were burning in the respiratory tract and eyes, blepharospasm, breathlessness, stomach pains and vomiting. The causes of deaths were choking, reflexogenic circulatory collapse and pulmonary oedema. Findings during autopsies revealed changes not only in the lungs but also cerebral oedema, tubular necrosis of the kidneys, fatty generation of the liver and necrotising enteritis. The stillbirth rate increased by up to 300 % and neonatal mortality rate by 200 %.

Hydrogen cyanide or not ?

- a) The issue of hydrogen cyanide being present in the gas mixture or not is still a controversy. MIC starts breaking down to hydrogen cyanide (HCN) already at 200°C. Concentrations of 300 ppm can lead to immediate collapse. Many of the deaths and acute symptoms could be explained by HCN exposure.
- b) The non-toxic antidote sodium thiosulfate (NaTs) in intravenous injections increases the rate of conversion from cyanide to non-toxic thiocyanate. Treatment was suggested early, but because of confusion within the medical establishments, it was not used on larger scale until June 1985.

Long term health effects

- a) The quality of the epidemiological and clinical research varies. Reported and studied symptoms are eye problems, respiratory difficulties, immune and neurological disorders, cardiac failure secondary to lung injury, female reproductive difficulties, and birth defects among children born to affected women. Other symptoms and diseases are often ascribed to the gas exposure, but there is no good research supporting this;
- b) Union Carbide as well as the Indian Government long denied permanent injuries by MIC and other gases. In January, 1994, the International Medical Commission on Bhopal (IMCB) visited Bhopal to investigate the health status among the survivors as well as the health care system and the socio-economic rehabilitation; and

- c) The reports from Indian Council of Medical Research were not completely released until around 2003.

For a review of the research on the health effects of the Bhopal disaster, see Dhara & Dhara (2002).

Aftermath of the leakage

- a) Medical staff were completely unprepared for the thousands of casualties;
- b) Doctors and hospitals were not informed of proper treatment methods for MIC gas inhalation. They were told to simply give cough medicine and eye-drops to their patients;
- c) The gases immediately caused visible damage to the trees. Within a few days, all the leaves fell off;
- d) 2,000 bloated animal carcasses had to be disposed of;

- e) "Operation Faith" On december 16, the tanks 611 and 619 were emptied of the remaining MIC. This led to a second mass evacuation from Bhopal;
- f) Complaints of a lack of information or misinformation were widespread. Not even the medical doctor at the Bhopal plant had proper information about the properties of the gases. An Indian Government spokesman said that "Carbide is more interested in getting information from us than in helping our relief work.";
- g) As of 2008, UCC has not released information about the possible composition of the cloud; and
- h) Formal Statements were issued that air, water, vegetation and foodstuffs were safe within the city. At the same time, people were informed that poultry was unaffected, but were warned not to consume fish.
- d) In 1989 a settlement was done where UCC agreed to pay US\$ 470 million (the insurance sum plus interest) in full and final settlement of its civil and criminal liability; and
- e) When UCC wanted to sell its shares in UCIL, it was directed by the Supreme Court to finance a 500-bed hospital for the medical care of the survivors. Bhopal Memorial Hospital and Research Centre (BMHRC) was inaugurated in 1998. It was obliged to give free care for survivors for eight years.

Economic rehabilitation

Compensation from Union Carbide

- a) The Government of India passed the Bhopal Gas Leak Disaster Act that made the government right to represent all victims in or outside India;
- b) UCC offered US\$ 350 million, the insurance sum;
- c) The Government of India claimed US\$ 350 billion from UCC;
- a) After the accident, no one under the age of 18 was registered. The number of children exposed to the gases were at least 200,000;
- b) Immediate relief was decided two days after the tragedy;
- c) Relief measures commenced in 1985 when food was distributed for a short period and ration cards were distributed;
- d) Widow pension of the rate of Rs 200/per month (later Rs 750) was provided;
- e) One-time ex-gratia payment of Rs 1,500 to families with monthly income Rs 500 or less was decided;
- f) Each claimant was to be categorised

by a doctor. In court, the claimants were expected to prove "beyond reasonable doubt" that death or injury in each case was attributable to exposure. In 1992, 44 percent of the claimants still had to be medically examined;

- g) From 1990 interim relief of Rs 200 was paid to everyone in the family who was born before the disaster;
- h) The final compensation (including interim relief) for personal injury was for the majority Rs 25,000 (US\$ 830). For death claim, the average sum paid out was Rs 62,000;
- i) Effects of interim relief were more children sent to school, more money spent on treatment, more money spent on food, improvement of housing conditions;
- j) The management of registration and distribution of relief showed many shortcomings; and
- k) Because of the smallness of the sums paid and the denial of interest to the claimants, a sum as large as Rs 1,000 crores is expected to be left over after all claims have been disposed of.

Occupational rehabilitation

- a) 33 of the 50 planned worksheds for gas victims started. All except one

was closed down by 1992;

- b) 1986, the MP government invested in the Special Industrial Area Bhopal. 152 of the planned 200 worksheds were built. In 2000, 16 were partially functioning; and
- c) It is estimated that 50,000 persons need alternative jobs, and that less than 100 gas victims have found regular employment under the government's scheme.

Habitation rehabilitation

- a) 2,486 flats in two and four storey buildings were constructed in the "Widows colony" outside Bhopal. The water did not reach the upper floors. It was not possible to keep cattle. Infrastructure like buses, schools etc was missing for at least a decade.

Healthcare

- a) In the immediate aftermath of the disaster, the health care system became tremendously overloaded;
- b) Within weeks, the State Government established a number of hospitals, clinics and mobile units in the gas-affected area;
- c) Radical health groups set up JSK (the People's Health Centre) that was working a few years from 1985;
- d) Since the leakage, a very large

number of private practitioners have opened in Bhopal. In the severely affected areas, nearly 70 percent do not appear to be professionally qualified;

- e) The Government of India has focused primarily on increasing the hospital-based services for gas victims. Several hospitals have been built after the disaster. In 1994, there were approximately 1.25 beds per 1,000, compared to the recommendation from the World bank of 1.0 beds per 1,000 in developing countries;
- f) The Bhopal Memorial Hospital and Research Centre (BMHRC) is a 350-

bedded super speciality hospital. Heart surgery and hemodialysis of kidneys are done. Major specialities missing are gynaecology, obstetrics and paediatrics. Eight mini-units (outreach health centres) were started. Free health care for gas victims should be offered until 2006. The management has not been without problems; and

- g) Sambhavna Trust is a charitable trust that registered in 1995. The clinic gives allopathic (western) and Ayurvedic treatments to gas victims, free of charge.

15.2. Subject/Theme:

Nuclear and Radiological Emergencies: Preparedness and Response

PART-I

Introduction and Overview

One of the scariest things about nuclear power is when something goes wrong and an accident occurs - **radiation is released into the environment** and people get exposed to radiation. Based on nature of events, nuclear accidents or radiation accidents may result into a disaster. An example of nuclear accident might be one in which a **reactor core** is damaged such as in the **Three Mile Island accident**, or the Fukushima accident. Because of extreme precautions taken at Nuclear Plants such accidents are very rare. But a more serious danger could be from various radiological equipments very commonly used and scattered all over the country. If such an equipment is continuously handled, they have as much or even greater ability to cause serious harm to both workers and the public than the well known nuclear accidents. The Mayapuri, Delhi incident is a glaring example

Radiation accidents are more common than nuclear accidents, and are often limited in scale. With increased emphasis on power/energy production using nuclear technology, there is an urgent need to

spread awareness about **function and soft measure**. There is a worldwide concern about safety of nuclear facilities and reactors.

Nuclear bombs are referred to as **Weapons of Mass Destruction** (WMD) and nuclear wars are called as **Mutually Assured Destruction** (MAD). A single thermonuclear weapon can cause severe radiation damage hundreds of miles beyond the location where it is exploded. If enough of such weapons are exploded in an all-out war it might render the entire earth, or large parts of it, uninhabitable.

Radiation incidents may be unintentional, as in nuclear power plant mishaps, or intentional, as in terrorist attacks with "dirty bombs," or detonation of a nuclear weapon. The nuclear explosion will result in total destruction in the immediate vicinity of the center of the explosion, ranging down to moderate damage further away. Secondary damage will result from firestorms, the windstorms which spring up at the edge of the devastated area, and from fires started in damaged structures. The casualties will be of three kinds:

- a) Those suffering injuries from burns and blast as a result of the direct forces of the explosion;
- b) Those suffering from the effects of radiation; and
- c) Those suffering ordinary injuries which follow any destructive episode, sustained fire fighting, wrecked and ruined structures, cuts from flying glass and debris, etc.

In many cases, ordinary injuries will be complicated by radiation burns or radiation sickness.

Children are much more vulnerable to the harmful effects of radiation disasters than the general population because their bodies absorb and metabolize substances differently, and because they are more likely to develop certain cancers from such an exposure. They also are closer to the ground, where radioactive fallout settles. In addition to physical harm, children may suffer from loss of parents, separation from their homes, and post-traumatic stress.

In India the **Department of Atomic Energy** is the nodal Agency in respect of manmade radiological emergencies. Nuclear facilities in India have guidelines for safety of the public and environment. A crisis management system is in place to take care of any possible nuclear hazard. Emergency response plans are also in place within the facility to handle local emergencies. Yet it is important to educate the public about this disaster and how to face it. The **Chernobyl Nuclear accident** in Russia has shaken the nuclear scientists all over the world.

Objectives

- a) To orient officials, volunteers and personnel of civil defence and other organisations designated for 'Nuclear and Radiological Emergencies: Preparedness and Response'; and

- b) To enable the trainees to plan and organize civil protection measures against nuclear disaster

Methods

Presentation cum discussion and practical, field visits

Materials/Learning Aids

Power points, slides, pictures, posters and video clips

Duration

Two sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/Knowledge related:

- a) Understand about radiological emergencies, nuclear weapons and their consequences as well as preparedness/prevention measures.

Competency/Skill related:

- a) Enhanced ability to Plan, organise and co-ordinate preparedness and response, initiating civil defence measures; and
- b) Ability to formulate local policies and plans to meet the emergency.

Sub-themes/Key learning points

- a) Defining Structure of Atom (Proton, Neutron and Electron), Radioactivity, Ionizing Radiation, Isotope, Curie, Becquerel, Half life, Fission, Fusion, Radiation dose;

- b) Penetrating power of different ionizing radiation;
- c) Natural and man-made radiation;
- d) Radiation dose and dose units – Absorbed dose, Equivalent dose, Effective dose, Radiation weighting factor, Tissue weighting factors;
- e) External dose, Internal dose;
- f) Effects of radiation – Somatic effect, Genetic effect, Deterministic effect and Stochastic effect;
- g) Radiation dose limits;
- h) Radiation Protection: Methods of time, distance and shielding;
- i) Radiation detection and monitoring instruments;
- j) Contamination, Decontamination, Methods of decontamination;
- k) Personal Protective Equipments;
- l) Various types of emergencies;
- m) Nuclear and Radiological Emergencies at Nuclear/Radiological Facilities;
- n) Nuclear terrorism and other radiological threats;
- o) RDD, Counter Measures for Prevention, Emergency Response for RDD;
- p) Nuclear and radiological accidents – TMI, Chernobyl and Goiania (Brazil) accidents;
- q) Nuclear Explosion, Effects of nuclear weapons, Effects of explosions at Hiroshima and Nagasaki;
- r) Emergency Preparedness;
- s) Emergency Response Centre (ERC) and Emergency Response Teams (ERTs);
- t) Community Development;
- u) Role of First Responder;
- v) Counter measures to cope with nuclear emergencies in general; and
- w) Dos and Don'ts following a nuclear accident/explosion.

Supplementary Learning Support Material

- a) Handout on the structure of atom;
- b) Handouts on all kinds of radiation and their effects;
- c) Personal protective equipment;
- d) Nuclear and radiological emergency and disaster scenarios;
- e) Accidents in nuclear power plants and other facilities in nuclear fuel cycle nuclear/radiological terrorism and sabotage;
- f) Physical characteristics of nuclear explosions and their effects;
- g) Handout on emergency preparedness;
- h) Slide on community development;
- i) Handout on role of first responders;
- j) Suggested radius of inner cordoned area for radiological emergencies
Flowchart for response action by the first responder; and

k) Counter measures and do's and don'ts following a nuclear accident/explosion.

linkage with disaster management;

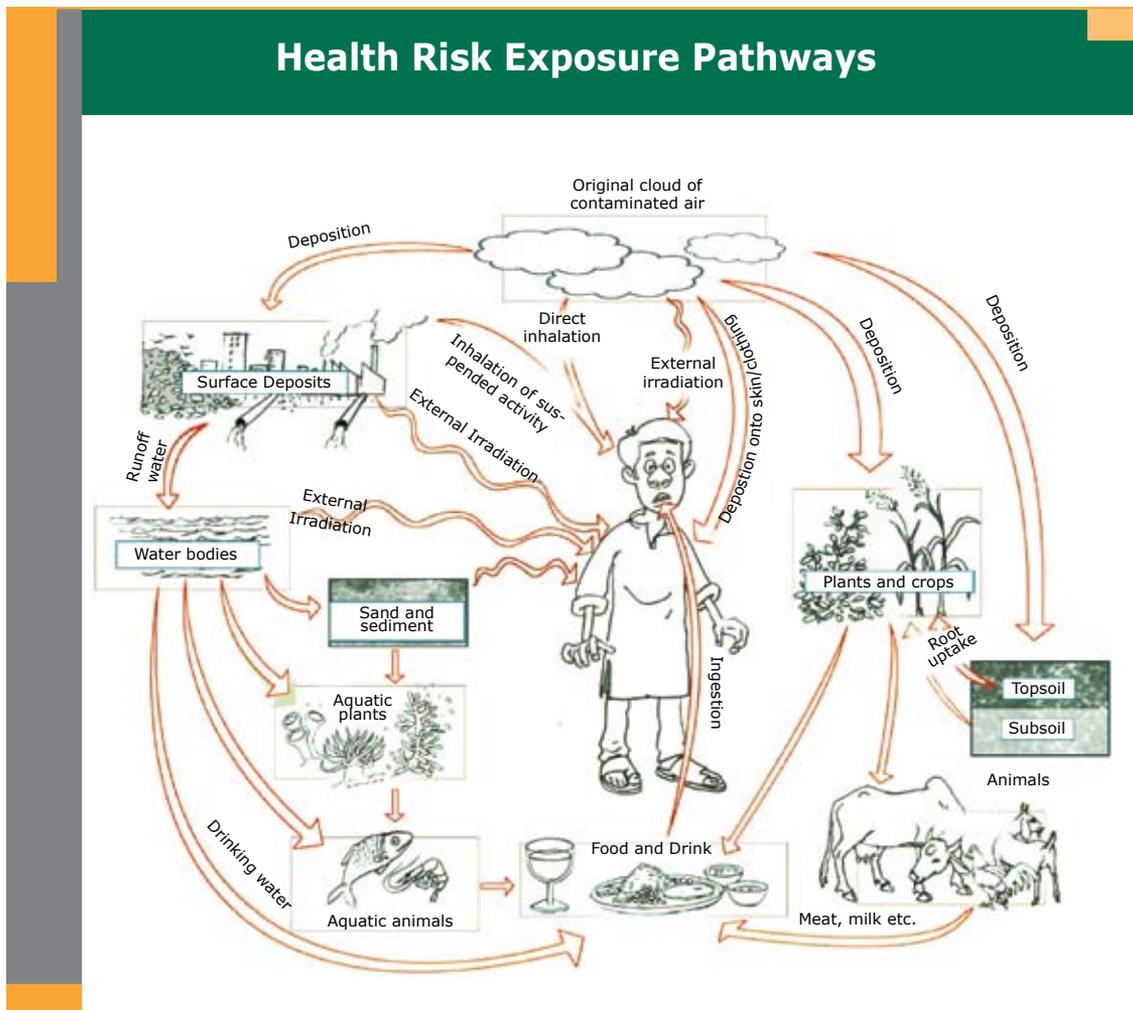
b) Conduct a brainstorming after showing video clips; and

c) A panel discussion with experts will be helpful.

Note for the Trainer/Facilitator

a) Note that this is a highly technical and politically sensitive subject. Due care should be taken to select resource persons who have through understanding of the subject and its

Source: IAEA technical report ISBN 92-0-129191-4 Vienna 1991



PART-II: Supplementary Learning Support Materials

SLS - 1

*Handout***Structure of Atom**

Everything on earth is made up of elements or by a different combination of elements. 92 elements starting from Hydrogen (atomic number 1) to Uranium (atomic number 92) are found in nature. In addition scientists have made many new elements like plutonium, americium, etc in the laboratory. The smallest unit of element is an atom. An atom consists of 2 parts, Nucleus and Electrons. The nucleus is the central core which contains protons and neutrons and occupies very small volume compared to the total volume of the atom. Electrons are lighter particles and revolve around the nucleus in different orbits and are negatively charged. Protons possess positive charge and neutrons are electrically neutral. In an atom the number of protons and number of electrons are equal and as they are oppositely charged, therefore, an atom is electrically neutral. A typical picture of an atom (Fig.1) is given below. Atoms of every element are unique by way of number of protons, neutrons and electrons.

Mass of proton and neutron is nearly same and is about 2000 times that of an electron. The number of protons or the number of

electrons of an atom is known as its atomic number Z . It is unique for each element. Sum of protons and neutrons in an atom is called mass number and is represented by A .

Large number of atoms of same type when collected together in one place, we call the substance formed by these atoms an element.

Radioactivity

Spontaneous emission of invisible radiation by certain unstable species of nuclei (man-made or naturally occurring) unaffected by chemical reactions, temperature or other physical factors.

Radiation

Energy emitted from a radioactive atom/source is known as radiation. The three main types of radiations emitted by radioactive substances are alpha (α), beta (β) rays and photons (Gamma (γ) rays). Like γ -rays, X-rays also are electromagnetic radiation with similar properties, however, source of origin of both γ -rays and X-rays are different. Neutron is yet another type of radiation, which is emitted during a nuclear fission.

Alpha Particle

It is emitted during radioactive decay. An alpha particle is a doubly ionized helium nucleus which consists of two protons and two neutrons and is positively charged. It is not an external hazard but is a serious internal hazard. It can be stopped by the outer layer of skin or a thin layer of paper or cloth.

Beta Particle

These particles are emitted during radioactive decay. Beta particles are nothing but electrons. They will normally penetrate a centimeter of tissue. Compared to alpha particles their external hazard is higher. They can cause burns on the skin. Through an internal hazard, but of lesser magnitude compared to that of alpha particles. In some radioactive decay, a positron is emitted which is a particle similar to electron but having positive charge.

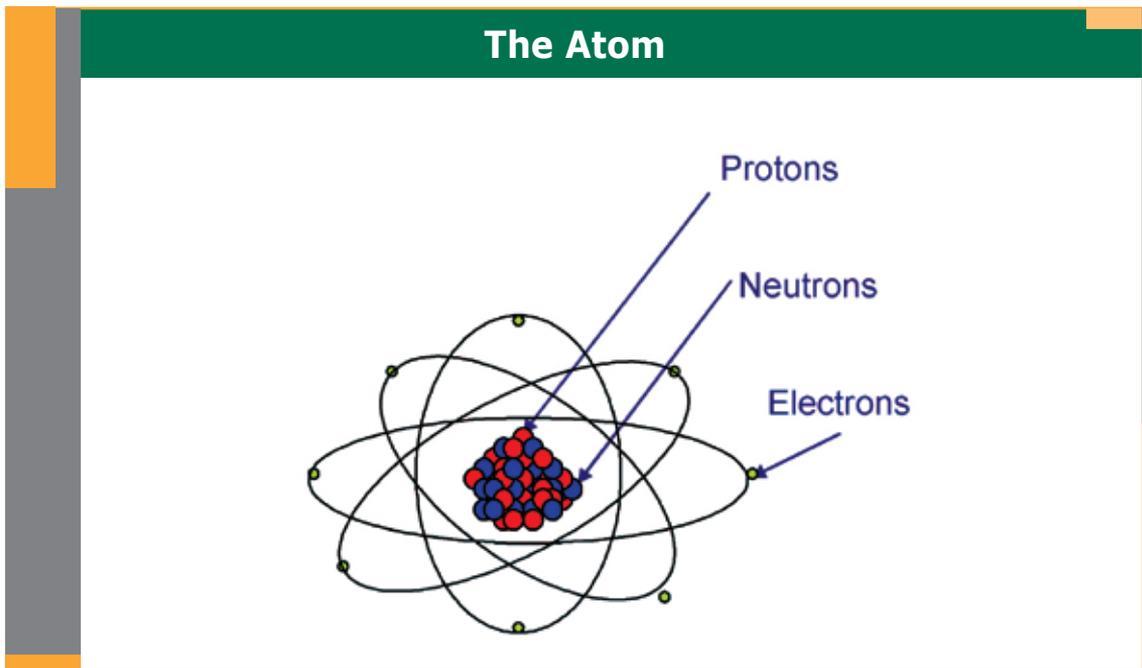
Gamma Rays

These are electromagnetic radiation (thus move with the speed of light) with wave length shorter than that of ordinary light or X-rays, therefore comparatively more penetrating. Gamma rays are emitted during radioactive decay. They can travel long distances and have high penetrating power compared to alpha and beta particles. High density material like lead is used for stopping γ -rays.

Neutron

A neutral particle normally produced in fission, fusion, or nuclear reactions. Being neutral particle, these are highly penetrating. Hydrogenous materials like water, paraffin etc are best for slowing down the neutrons (reducing their energy) by collision. Neutrons do not directly ionize the matter, but can produce a charged particle/atom by nuclear reaction, which can ionize the matter.

Fig. 1



Becquerel

One disintegration per second.

Curie

3.7×10^{10} disintegrations per second.

Fission

The process in which a heavy nucleus splits into two small, intermediate mass nuclei with release of energy and one or more neutrons. A neutron is normally utilised to induce this process. Spontaneous fission refers to the process in which the fission occurs spontaneously without the need to induce it by any external agency.

Fusion

An atomic reaction process where a heavier nucleus is formed from fusion of two smaller nuclei accompanied with the release of large amount of energy.

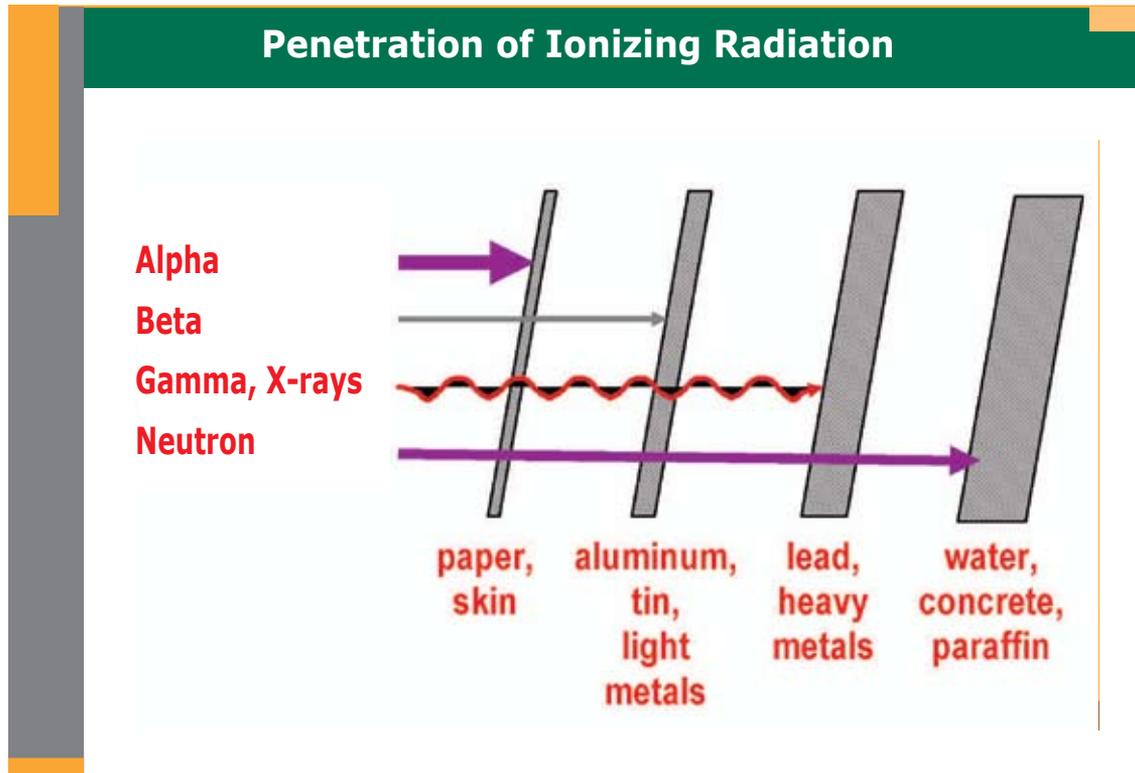
Half-Life

The time taken by a sample of radioactive material to decay down to half the number of its original atoms.

Penetrating power of different ionizing radiations is given in SLS - 2.

SLS - 2

Slide



SLS - 3

Handout

External and Internal Dose

When a person is handling radioactive material, he will be exposed to particles like alpha, beta or gamma emanating from the source. If the source is sealed then the person will get only external radiation dose. However, if a person is working with an open source or due to some accident the sealed

source loses its integrity, it is likely that part of the radioactive material may become airborne. In that case person may get externally contaminated and/or also may get internally contaminated, if he inhales, ingests or his skin absorbs the radioactive material. A radiation protection programme is meant to provide protection to the person both from external and internal exposure.

See annexure for technical terms and measures of radioactive substances.

SLS - 4

Handout

Protection form Radiation

External Radiation Protection

External radiation exposure is due to radiation originating from the radiation source outside the body; there is no physical contact with the radiation source when it is used. External radiation can be measured with ease and accuracy. Exposure of personnel to external radiation may be controlled by concurrent application of one or more of the following three techniques:

- a) Minimising exposure time (Time);
- b) Maximising distance from the radiation source (Distance); and
- c) Shielding the radiation source (Shielding).

In addition to the application of time, distance and shielding criteria, depending upon the situation two more criteria namely decay of the source and use of protective gears will also help in dose reduction to the individuals.

Internal Radiation Protection

Radioactive substance may gain entry into the body through three pathways namely inhalation, ingestion and absorption – through intact skin or through wounds. This will lead to internal exposure. The

seriousness of this hazard will depend upon the quantity of radioisotope and the dose it delivers. Accordingly, internal radiation protection is concerned with preventing or minimizing the intake of radionuclides into the body and the deposition of radioactivity on the body.

In the case of internal contamination, the radioactive material is deposited within the body. Once internally contaminated, the body organs of the person will continue to get irradiated till activity is excreted out or decays completely. In the context of potential harm, the radiation dose from an internally deposited radionuclides is no different from the same dose absorbed from external radiation.

SLS - 5

Handout

Sources of Radiation (Natural and man-made)

Since time immemorial, mankind has been continuously exposed to naturally occurring ionizing radiation. However, it was only towards the end of the nineteenth century that human beings became aware of it, when X-rays were discovered in 1895 by Wilhelm Roentgen and radioactivity in uranium salts was discovered by Henri Becquerel in 1896. This was followed by the discovery of nuclear fission in 1939 and the demonstration of a self-sustaining

chain reaction in natural uranium oxide in a graphite pile in 1942. Since then, there has been an exponential growth in the application of nuclear science and technology in the fields of power generation, medicine, industry, agriculture, research and defense. Today there are about 440 nuclear power reactors operating in 31 countries, meeting 16% of the world's

electricity needs. As on August 2007, 17 power reactors and 5 research reactors are in operation in India. Further, India uses nuclear radiation in a variety of applications in the fields of medicine, industry, agriculture and research. India is also one amongst the seven declared nuclear weapon States which uses nuclear technology for strategic purposes.

(a) Natural Sources of Radiation

- a) Cosmic Radiation
- b) Terrestrial Radiation
- c) Radon from decay of uranium/radium
- d) Due to radioactive elements present in the body
- e) Food we eat and water we drink also contain trace levels of radioactivity.
- f) From Building material

Note: On an average a person on earth receives a yearly dose of 2.4 mSv from natural sources of radiation.

(b) Man-made Sources of Radiation

- a) Medical – diagnosis and therapy
 - i. X-rays
 - ii. Nuclear medicine
 - iii. Radiation therapy
- b) Dose due to operation of nuclear cycle facilities
- c) Fallout from earlier nuclear tests
- d) After effect of Chernobyl accident
- e) From consumer goods namely
 - i. Tobacco
 - ii. Television
 - iii. Smoke detectors (americium)
 - iv. Lantern mantles (thorium)
 - v. Some luminous watches and dials (tritium)
 - vi. Airport X-ray systems
 - vii. Many other small sources of radiation

Note: During air travel a person receives slightly higher dose of cosmic radiation.

SLS - 6

Handout

Contamination and Decontamination

Contamination

The presence of radioactive substances in or on a material or the human body or other place where they are undesirable or could be harmful. In human body contamination can be external or internal. External contamination is measured in Bq/cm² of the surface area.

If contamination is not controlled it can spread to different areas by movement of personnel or by movement of material, which is not desirable.

Decontamination

It is the removal of radioactive material from a location where it is not required.

In simple terms Contamination is the undesired presence of radioactive material where it is not needed. Contamination of personnel, equipment and area may occur either from normal operation or as a result of breakdown of protective measures.

Contamination may be either fixed or transferable (loose) type. In case of fixed contamination, the radioactivity can not be transmitted to personnel, clothing and equipment and the hazard consequently, is that of external radiation. In case of loose contamination radioactivity can transmit to personnel, clothing, equipment etc. Thus the hazard from loose contamination arises due to the possibility of transmission of the radioactive material into the body by inhalation, ingestion and/or absorption through skin/wounds.

The spread of contamination can be controlled by cordoning the affected area and access control. Good house keeping, proper ventilation (in case of plants/facilities) and use of personal protective gears prevent the spread of contamination.

Spread of contamination should be avoided during decontamination. In majority of the cases water and soap are the best decontaminating agents. Personal decontamination procedure should be gentle and care should be taken to prevent injury to the skin otherwise it may lead to absorption of radionuclides.

SLS - 7

Handout

Biological Effects of Nuclear Radiation

Deterministic effect

The effect of radiation on human health for which there is generally a threshold level of dose above which the severity of the effect is greater for a higher dose.

Stochastic effects

Radiation effects, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose.

Health Effects

The exposure to large doses of radiation or due to deposition of radioactive material externally or internally within the body may lead to radiation injuries or radiation effects which manifest immediately or during the lifetime of an individual (such individual effects are called somatic effects) or hereditary effects (also called genetic effects), which may appear in the future generations. Immediate somatic effects could be radiation sickness, death of the individual and early or late expression of

damages in radiosensitive organs. Such effects are termed as deterministic effects and include haematopoietic syndrome, gastrointestinal syndrome, Central Nervous System (CNS) syndrome, pneumonitis, cataract, sterility, skin erythema, skin burns etc. Exposure during pregnancy can result into prenatal death, neonatal death, mental retardation, childhood cancer etc. Induction of cancer and genetic disorder in the progenies of the exposed are the two main stochastic effects, (which do not have threshold of dose as the case with the deterministic effects). Acute radiation syndrome for gamma radiation are given in SLS -8.

Psycho-social Effects

Radiation exposure in a radiation accident or nuclear explosion can result in numerous psychiatric disorders in exposed individuals, depending upon the type of accident, distance of the patient from the site of accident, psycho characteristics of the patient, time elapsed after the accident, etc. Common post-disaster disorders include Anxiety, Acute Organic Brain Syndrome, Post Traumatic Stress Disorder (like flashbacks, nightmares, irritability, dysfunction in normal routine, etc.), Depression, Numbness, Acute burst of fear, Panic or Aggression.

SLS - 8

Slide

Acute Radiation Syndrome for Gamma Radiation

Dose (Gy)	Symptoms	Remarks
0 - .25	None	No detectable effects
.25 - 1	Mostly none. A few persons may exhibit mild prodromal symptoms such as nausea, vomiting and anorexia.	Bone Marrow damaged, decrease in red and white blood-cell counts and platelet counts, lymphocyte count decreases.
1 - 3	Mild to severe nausea, vomiting, malaise, anorexia, infection, temporary sterility likely at higher dose range.	Hematologic damage more severe. Recovery probable though not assured.
3 - 6	Severe effects as above, plus hemorrhaging, infection, diarrhea, epilation, temporary/permanent sterility.	Fatalities will occur-about 50% in the range 4.5-5.0 Gy in 30 days. 5030 LD Lethal dose. This is referred to as bone marrow death.
6 - 10	Nausea and vomiting within 15-30 minutes, lasting for 2 days, plus severe effects as above.	Fatalities: 90-100% within 1-6 weeks.
10 - 25	Nausea and vomiting within 5-30 minutes; no latent period at higher doses, incapacitation at dose above 10 Gy, Gastrointestinal Syndrome follows - Certain Death.	Fatalities: 100 % within 4-14 days.
> 25	Immediate nausea, vomiting, diarrhea and fever. Impairment of central nervous systems (CNS Syndrome) at 30 Sv or above. Certain Death.	Fatalities: 100 % within a day or two.

SLS - 9

Handout

Personal Protective Equipment (PPE)

When a person is working in an area where there is a high concentration of radioactivity in the air, then he needs (i) respiratory protection so that he does not breathe radioactive dust and (ii) external protection so that he does not get contaminated.

For respiratory protection a person can use filter type respirators, fresh airline respirators (it cannot be used in the field normally), self contained breathing apparatus (SCBA), etc. Best protection is offered by SCBA.

Depending upon the situation a worker can wear protective gear such as coveralls, caps, plastic suits, face masks, gloves, shoes, shoe covers etc. Use of full body covering plastic suit will save one from getting contaminated and also will prevent entry of some radionuclides (e.g. tritium) into the body through the intact skin by skin absorption.

NBC Suit – Nuclear, Biological and Chemical suit. NBC Suit is a personal protective equipment designed to provide protection against any direct contact with and contamination by radioactive, biological or chemical substances, and may

provide some protection against radiation, depending on the design. However, it cannot provide protection against high energy gamma radiation. NBC suit is now known as CBRN Suit. CBRN stands for Chemical, Biological, Radiological and Nuclear.

SLS - 10

Handout

Nuclear and Radiological Emergency/Disaster Scenarios

Any radiation incident resulting in or having a potential to result in exposure to and/or contamination of the workers or the public, in excess of the respective permissible limits can be termed as nuclear/radiological emergency. These emergencies, which are usually well within the coping capability of the plant/facility authority (along with neighbouring administrative agencies, if required) can be broadly classified in the following manner:

- a) An accident taking place in any nuclear facility of the nuclear fuel cycle including the nuclear reactor or in a facility using radioactive sources, leading to a large scale release of radioactivity in the environment;
- b) A "criticality" accident in a nuclear fuel cycle facility where an uncontrolled nuclear chain reaction takes place

- inadvertently leading to bursts of neutrons and gamma radiations (as happened at Tokaimura, Japan);
- c) An accident during the transportation of radioactive material;
 - d) A malevolent use of radioactive material as Radiological Dispersal Device (RDD) by terrorists for dispersing radioactive material in the environment; and
 - e) A large-scale nuclear disaster, resulting from a nuclear weapon attack (as happened at Hiroshima and Nagasaki cities of Japan) which would lead to mass casualties and destruction of large area and property. Unlike a nuclear emergency, the impact of nuclear disaster is beyond the coping capability of the local authorities and such a scenario calls for handling at the National level.

SLS - 11

Handout

Accidents in Nuclear Power Plants and other Facilities in the Nuclear Fuel Cycle

The nuclear fuel cycle covers the entire range of activities associated with the

generation of nuclear power and it includes uranium mines & mills, fuel fabrication facilities, nuclear power plants (NPPs), reprocessing plants and radioactive waste management facilities.

The nuclear emergency scenarios at various nuclear fuel cycle facilities may arise due to failure of systems and equipment and/or human errors.

A National regulator, which in India's case is the Atomic Energy Regulatory Board (AERB), stipulates on-site or off-site emergency level depending on whether the radioactivity is confined within the fence of the facility or crosses the facility boundary and enters into the public domain.

Criticality Accidents

These refer to those incidents taking place at facilities other than a nuclear reactor (where the fission is normally intended to occur for power generation). Criticality accidents occur when an uncontrolled nuclear chain reaction takes place inadvertently in facilities handling high-grade fissile material such as enriched uranium or plutonium, releasing bursts of neutrons and gamma radiation. Though the possibility is remote, the "criticality" situation may arise due to breach of safety procedures that lead to vital changes in system parameters like mass, volume and

shape. It could cause induced radioactivity in the surroundings and also release radioactive material in the immediate vicinity. All these will be dangerous to the nearby personnel who could even face the risk of injury or death. It may be noted that these events are not nuclear explosions.

The effects of such accidents would be confined to the facility itself and at the most, may extend to the limited area surrounding the facility. The general public is not likely to be affected by such accidents.

Accidents at Facilities using Radioactive Sources

With the increase in applications of radiation in medicine, agriculture, industry and research, a large number of radioactive sources are in the public domain. These range from relatively low intensity sources used in nucleonic gauges to large sources are used in industrial irradiators for sterilization of medical products, preservation of food etc. The mishandling of such sources, their loss during use or transportation, or accidents like a fire in the building where the source is present, could result in a radiation emergency with the possibility of radiation exposure to the public.

SLS - 12

Handout

Nuclear/Radiological Terrorism and Sabotage at Nuclear Facilities

In the emerging security scenario, the possibilities of nuclear terrorism by use of an Improvised Nuclear Device (IND), or use of a RDD or the sabotage of a nuclear facility, are the emergency scenarios that need to be addressed.

The acquisition of the requisite quantity of high grade fissile materials (uranium-235 or plutonium-239) needed for producing an IND is not an easy task, since these materials are kept in highly secured places the world over. However, such material may be procured outside the country in a clandestine manner, and brought illegally into the country then, there is some probability, of diverting the same for an IND.

Radioactive sources are widely used for various applications. While their radioactive strength is in itself a deterrent to being stolen, still they have the potential of being stolen and used in a RDD. RDD is a conventional explosive device in which

some radioactive material has been mixed such that, on its being exploded, there would be dispersal of the radioactivity in the public domain. RDD does not involve any atomic or nuclear explosion and hence is not a weapon of mass destruction (WMD). At worst it can be called a weapon of mass disruption. Detailed analysis shows that use of RDD would not give rise to any significant radiological problem. However, the radioactive contamination due to dispersal of radioactive material, though not of any major radiological significance, has the potential of causing panic and denial of access for a significant time period to the area around the location of the explosion. The use of a RDD by itself would not result in fatalities due to radiation, the fatalities, if any, would primarily be due to the explosion. Emergency response measures would need to be in place to respond to such situations.

As regards the vulnerability of nuclear fuel cycle facilities like nuclear reactors, fuel fabrication facilities, reprocessing facilities, etc., to terrorists attack, these units have elaborate physical security arrangements in place to ensure their security. The structural design of these facilities ensures that even in the event of a physical attack, the structure would prevent the release of any radioactivity into the public domain. In case of nuclear reactors, even in the remote likelihood of these being breached, it would automatically result in the safe shutdown of the reactor by itself. It is well recognised that the assistance of an insider

is essential for carrying out any such sabotage. Systems are in place to detect such acts, though an act of sabotage can never be ruled out completely.

SLS - 13

Handout

Nuclear Weapons and their Effects

In a time, immediately following a nuclear blast, the explosion energy is transferred in the surrounding medium in three distinct forms; blast, thermal and nuclear radiations. Broadly, for a 20 kT fission device exploded at a height of 180m or higher above the ground, the distribution of the energy released in the form of blast, thermal and nuclear radiations (both prompt and delayed) are 50%, 35% and 15%, respectively, (See SLS – 13b)

The extent of the damage caused by a nuclear bomb depends upon various factors viz., the type of bomb (the material used for the bomb whether it is U-235 or Pu-239 and additional material if it is of thermonuclear type), yield of the bomb, height at which it is detonated (upper atmosphere, lower atmosphere, surface, underground, under water), the prevailing atmospheric conditions like temperature, humidity, etc; the topology of the site like flat ground, hilly terrain, by the side of a sea or river, the time of detonation, etc. For a bomb of given size there is a definite height at which the area affected by the blast wave of given strength would be largest and the number of deaths and

injured will be maximum. Damage due to bombings at Hiroshima and Nagasaki is given in SLS-13c.

Blast Effect

A sudden burst of a large amount of energy causes very high temperature and pressure in the surrounding air, resulting in extremely hot and compressed gases. The hot and compressed air expands and rises rapidly initiating a powerful blast wave or shock wave in other medium like water or earth (in case of underwater or underground explosion), causing widespread destruction of property and rupture of ear drums. This is accompanied by a hurricane type, very strong wind causing further damage, including picking up people or vehicles and hurling them into any other object.

Thermal Effect

The extremely high temperature of the air causes intense flash of light accompanied by a powerful pulse of heat (thermal) radiation, sufficient to set fire and cause third degree burns up to a distance of few kilometers, depending upon the yield. Finally, it results in a firestorm due to the availability of more and more combustible material.

Initial Nuclear Radiations

The nuclear explosion is accompanied by an intense pulse of highly penetrating ionising radiations called "initial radiation" that is capable of delivering lethal radiation dose to the people but in a region which might

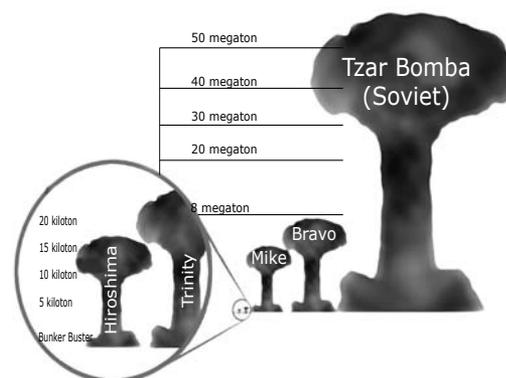
be already devastated due to thermal and blast wave. Generally, the initial nuclear radiation refers to the radiations emitted in the initial one minute after the explosion.

Radioactive Fallout

Finally, the residual radioactive substance which might be either in the form of gases or may get attached to the dust particles, sucked up from the earth by the rising fire ball (if it touches the ground, depending upon the height of burst) will come down slowly and will contaminate a very large area-up to several tens or hundreds of kilometers-depending upon yield, height of burst and weather conditions. This fallout of radioactive material will have its effect on the people and the environment for years to come. The fallout may be greatly reduced, if the explosion occurs in the air at an altitude greater than a height called the "optimum height".

Electro Magnetic Pulse (EMP)

The ionizing radiations, while passing through the air, produce a large number of free electrons and residual ions. This



The nuclear tests carried out so far

concentration of electrons at high altitudes (EMP) can seriously disturb the propagation of radio waves, thereby disturbing the communication over a large area, depending upon the height of burst. This

EMP is capable of damaging unprotected electronic and electrical systems including communication, command and control centres, power plants, etc. located over a very large area.

SLS – 13a

Slide

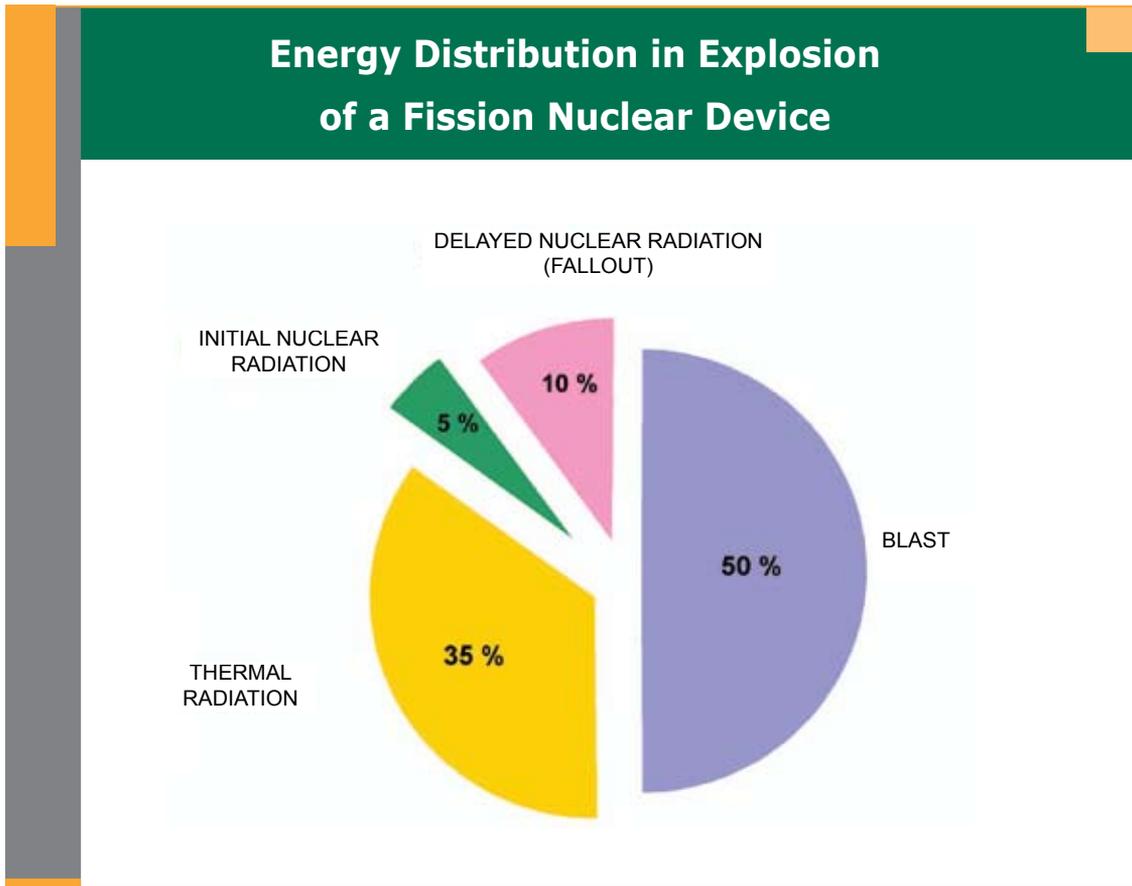
Physical Characteristics of Nuclear Explosions & their Effects

Phenomena occurring when nuclear weapons are exploded:

- a) Fire Ball**
- b) Blast wave**
- c) Thermal wave (Heat radiation)**
- d) Radiation (neutrons and gamma rays)**
 - i) Prompt radiation**
 - ii) Delayed radiation**
 - a) Local radioactive fallout**
 - b) Global radioactive fallout**
- e) Electromagnetic pulse**
- f) Atmospheric disturbances**

SLS - 13b

Figure



SLS – 13c

Table

General Details of A-Bombings (1945) and their Effects

Sr. No.	Details	Hiroshima	Nagasaki
1	Date and Time of Bombing	August 6, 1945 08.15 hrs	August 9, 1945 11.02 hrs
2	Bomb Core Material	Uranium 235	Plutonium 239
3	Bomb Structure	Gun Type	Implosion Type
4	Bomb Yield	15 kt (TNT)	21 kt (TNT)
5	Radiation Released	Mostly gamma	Mostly gamma
6	Burst Height	580 m up in air	503 m up in air
7	Humidity	80%	71%
8	Fallout	Minimal	Minimal
9	Total Area Burnt	13.7 km ²	6.7 km ²
10	City Structure	Flat, Densely Populated	Hilly, Less Populated
11	Property Loss (Myen – 1945 value)	884	380

General Details of A-Bombings (1945) and their Effects (Contd...)

Estimation of Casualties	Hiroshima	Nagasaki
Pre-raid population	255,000	195,000
Dead	66,000	39,000
Injured	69,000	25,000
Total Casualties	135,000	64,000

The nuclear tests carried out so far

SLS - 14

Handout

Emergency Preparedness

In case of a nuclear or radiological emergency the prime concern will be the health and safety of the workers and public. Since such an accident can lead to high doses to the people and radioactive contamination of the environment, a detailed emergency preparedness program should be in place. The main requirement for this is to have adequate equipment, trained man-power and other infrastructure in the State of readiness, so that if an event occurs, the response action can start immediately; in order to mitigate the consequences of the event so as to minimise the loss/damage of the man, machine and environment.

To respond effectively to an emergency, a well-defined organisational set up is to be established and responsibilities are to be allocated appropriately. The following are the important agencies involved in the management of Nuclear/Radiological emergencies:-

- | | |
|---|--|
| <ul style="list-style-type: none"> a) Emergency Response Centres; b) Radiation monitoring group; c) Decontamination centres; d) Police; e) Paramilitary forces; f) Civil defence; | <ul style="list-style-type: none"> g) Medical service; h) Meteorology; i) Fire fighting; j) Transport; k) Information and communication; and l) NGOs and welfare groups. |
|---|--|

Emergency Response Centre (ERC) &

Emergency Response Teams (ERTs)

To handle the nuclear or radiological emergencies in an effective manner in an area, Emergency Response Centre (ERC) is to be established from where all command and control will be executed. Other important agencies like State Government, Civil Defence, Police, Medical Authorities, NGOs etc will work in close liaison with this ERC. Various types of emergency relief teams are formed to carry out relief and rescue operations in the field. These teams will include experts from various disciplines. An action plan, which takes in to account the fastly changing situation, should be available for immediate execution. It may include various measures like distribution of iodine tablets, provision for immediate medical assistance, a scheme for evacuation, sheltering, control on food and water supply etc. This ERC should be equipped with all types of monitoring instruments, protective gears and communication facility.

For the management of nuclear emergencies, associated with each ERC, various Emergency Response Teams (ERTs) are to be identified. These ERTs are to be given periodic training and mock exercises should be conducted. The general tasks of the ERT are –

- a) to monitor the area and assess the radiological status;
- b) to provide medical assistance, advice and/or consultation, as necessary to public health;
- c) to carry out decontamination of the personnel area; and
- d) to provide assistance to the people in evacuation, relocation or any other type of assistance which may be needed depending upon the logistics and topography of the area affected.

SLS - 15

Slide

Community Development

Due to the fact that one cannot see, feel or smell the presence of radiation, coupled with lack of credible and authentic information on radiation and radiation emergencies, even a minor nuclear incident is invariably linked with sad memories of Hiroshima and Nagasaki – a fact that has been further aggravated by the wide publicity given to nuclear reactor accidents at TMI and Chernobyl. In major events, social – psycho care has, therefore, become an important dimension to be carefully addressed to.

To win their confidence, apprehensions of the community to be allayed and their ownership of the preparedness plan to be ensured through:

- a) Education, awareness generation and training
- b) Participation in off-site emergency exercises
- c) Sharing of the results of off-site emergency exercises
- d) Analysis and up-gradation of response programmes

SLS - 16

Handout

Role of First Responders

The mission of the First Responder Team is to assess and control the radiological impact in case of an emergency.

Monitors and Equipments required by first responders

The first responders have to be equipped with personal protective equipment (PPE) and monitoring instruments for assessment of the situation arising due to the accident. The instruments like personal dosimeter, portable radiation survey meters for alpha, beta and gamma measurement and air sampling devices are important part of the emergency kit required for assessment of radiological hazard, due to both high dose level and contamination.

The PPE, full body covering suit, respirators are required to protect first responders from any internal radiological hazard. The water tankers, hose and decontamination agents are used to decontaminate the personnel and fix the contamination to the ground if required.

Public address system, radiation symbols, tongs for handling the sources and polythene sheets etc will help the first responder to maintain the area and personnel control at the site.

Response action of the first responders

Taking into account the various emergency scenarios, IAEA has suggested the inner cordoned area as given in SLS -16a. The sequence of the actions to be followed by first responder are as follows (See SLS – 16b):-

- a) Inform Unified Commander/crisis management group/Emergency Response Centre immediately;
- b) Monitor and control the entry/exit to the area of the accident. Radiation detection instruments should be turned on before the team reaches the scene;
- c) Keep the public far from the incident scene and associated debris. Prohibit eating, drinking and smoking in the area;
- d) Perform life saving rescues and emergency first aid. If medical attention is needed, assist in arrangement of medical assistance. The medical personnel should be informed that radioactive contamination might exist on the victims and their clothings;
- e) In case of fire, fire personnel should be cautioned about the presence of radioactive material;
- f) In case of a transport accident, identify the hazard and if possible

obtain shipping papers, Transport Emergency Card (TREM CARD), Transport of radioactive material data (TREM DATA), high level nuclear waste shipping permits and documents;

- g) Keep maximum distance from radioactive material and suspected contaminated material, PPE and tools used at the scene should be checked for contamination;
- h) Identify all those who may have been exposed to a possible release of radioactive material. Identify those involved with the incident or potentially contaminated by the incident of the scene;
- i) All individuals will be monitored, decontaminated if necessary, and cleared after further medical treatment, if required; and

- j) Record names, addresses, destination and telephone numbers of those individuals who cannot be persuaded to stay at the incident scene.

In the event of a nuclear accident or radiological emergency, the effectiveness of measures taken to protect members of public or workers will depend upon the adequacy of emergency plans prepared in advance. The first responder may be from Defense, Civil Defence, Paramilitary or law enforcement personnel who also respond to other emergencies. They should have adequate knowledge of radiation protection in addition to monitoring techniques. First responder team is expected to have capability to deal with conventional accident in addition to the location and assessment of radiological hazard.

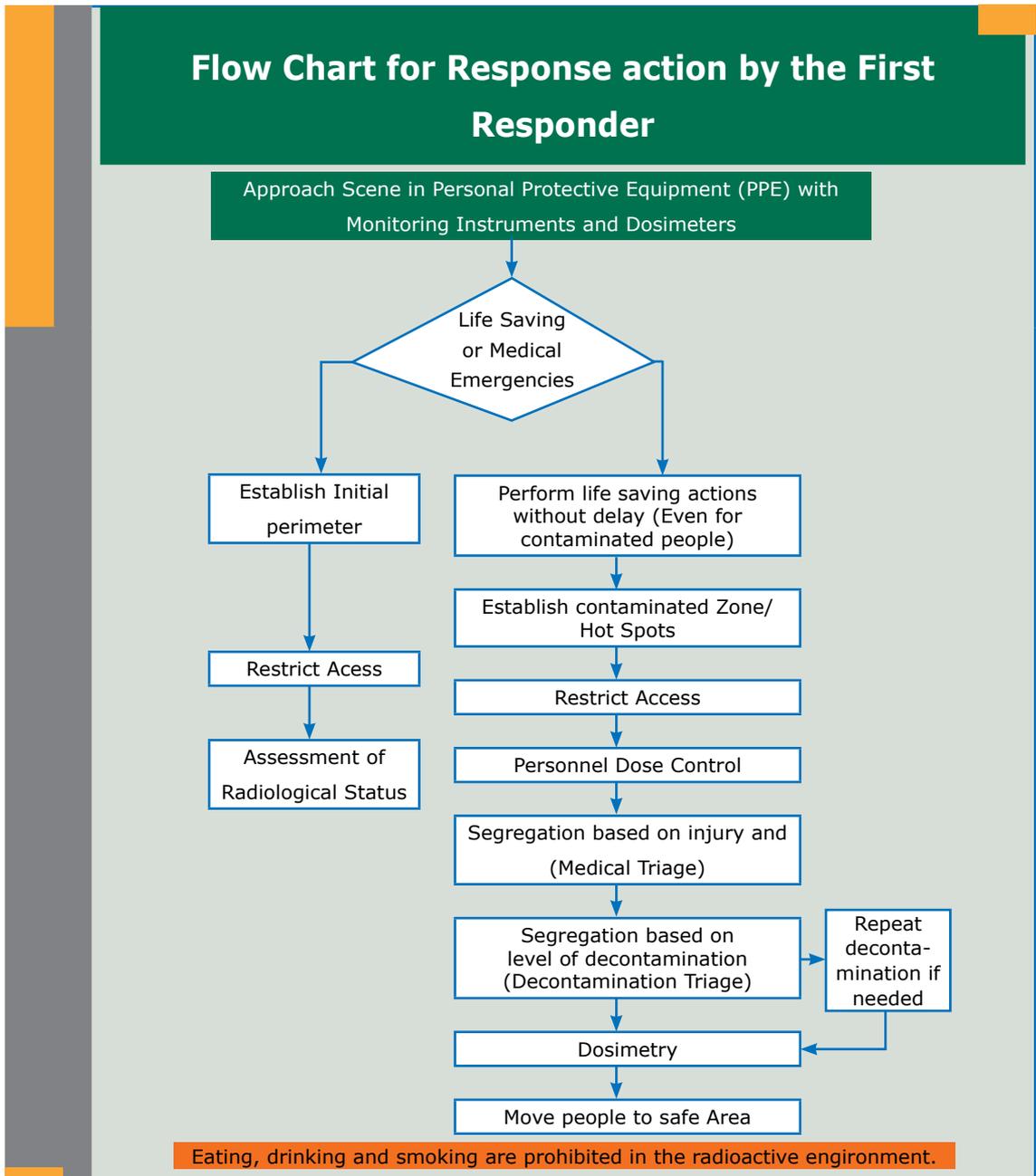
SLS – 16a

Table

Suggested Radius of Inner Cordoned Area (Safety Perimeter) for Radiological Emergencies (IAEA-EPR-FIRST Responders 2006)	
Situation	Initial inner cordoned area (safety perimeter)
Initial determination (Radiological Emergency in Open Area)	
Unshielded or damaged potentially dangerous source	30 m around
Major spill from a potentially dangerous source	100 m around
Fire, explosion or fumes involving a potentially dangerous source	300 m radius
Suspected bomb (potential RDD), exploded or unexploded	400 m radius or more to protect against an explosion
Initial determination (Radiological Emergency Inside a Building)	
Damage, loss of shielding or spill involving a potentially dangerous source	Affected and adjacent areas (including floors above and below)
Fire or other event involving a potentially dangerous source that can spread materials throughout the building (e.g. through the ventilation system)	Entire building and appropriate outside distance as indicated above
Expansion based on radiological monitoring	
Ambient dose rate of 100 μ Sv/h	Wherever these levels are measured

SLS - 16b

Figure



SLS - 17

Slide

COUNTERMEASURES

Depending upon the level of emergency number of countermeasures can be taken. Some of the important countermeasures are as follows:-

- a) Sheltering
- b) Radio-protective Prophylaxis (Distribution of iodine tablets)
- c) Respiratory Protection
- d) Body Protection
- e) Personal Decontamination
- f) Relocation
- g) Control of Access
- h) Food Control
- i) Evacuation, and
- j) Decontamination of Areas.

All countermeasures bring in their own problems and a balance has to be struck between the advantages expressed in terms of projected dose avoided and the cost of the countermeasures-both social and economic.

Not all counter measures can be taken in one shot. Depending upon the field conditions controlling officer will decide which countermeasures are best suited at that point of time. Please note that the above list of countermeasures is not exhaustive.

SLS - 18

Handout

Do's and don'ts following a Nuclear Accident/Explosion

- a) Do not look at the fire ball when explosion takes place. It may blind you or affect your vision;
- b) Protect your body parts from thermal burns and radiation by covering with cloth;
- c) If possible position yourself in a deep trench or an underground shelter to save yourself from blast, heat and radiation;
- d) At the time of the blast lie down on the ground immediately. Save your eyes and face. Close (cover) your ears to save eardrums;
- e) An accident in a nuclear facility having offsite consequences or explosion of a nuclear device can cause nuclear fallout. This fallout when settles on the ground will contaminate grass, soil, food, water etc. Therefore store enough emergency food items, water and item like babyfood;
- f) Do not store food and water in open. It may get contaminated. Similarly all the rivers, lakes, ponds, wells in the area may get contaminated. Do not use this water;
- g) Do not move out often;
- h) Listen to radio and TV and follow the

instructions, if any;

- i) Give first-aid to severely injured or burnt cases and move them to hospital;
- j) Close the doors and windows to save from fallout radiation;
- k) Remain indoors to save yourself from radiation and plume. Building will act as shield;
- l) Take bath and change clothes to decontaminate yourself;
- m) Cover your nose with wet handkerchief. It will stop radioactive dust being inhaled; and
- n) If advised evacuate the area or move to a temporary shelter.

General Don'ts to be followed in all types of emergencies

- a) Do not panic;
- b) Do not believe in rumours and don't spread rumours;
- c) Do not stay outside or go outside; and
- d) Do not disobey any instruction of the District or Civil defence authorities who will be doing their best to ensure the safety of you, your family and society as a whole and also try to save the property and the environment.

Source: SLS1 to SLS 17 - Dr. M. C. Abani, National Disaster Management Authority, New Delhi

SLS - 19

Case Studies

Major Nuclear Disasters

Three Mile Island (TMI) Accident

The pressurised water reactor of 900 Mw (e) situated at TMI, Pennsylvania U.S.A. suffered a serious accident on 28th March 1979. The accident at TMI can be considered as a combined effect of equipment malfunction, some design defects and operator error. The initial accident sequence which occurred in a period of minutes is as follows:

A feed water pump trip led to an absence of effective heat sink which led to rise in the primary system pressure. After about 15 minutes a pressure release valve opened correctly but failed to close properly when the coolant pressure dropped. This failure was not noticed by the operators for nearly 2 hours as a result of which large quantity of activity was discharged into the containment sump. Since the sump pumps were running at this time, some of the water was transferred to the auxiliary building outside the containment building. Faulty decision made during the water loss resulted in about half the fuel lacking the coolant. This gave rise to substantial fuel damage and release of fission products into the containment building. The gratifying fact was that despite a considerable release of radioactivity from the damaged fuel, no

significant exposure was suffered by the members of public. There was however, considerable anxiety regarding whether containment would hold. However, it proved to be effective. In spite of the fact that there was swift and catastrophic failure of the core, it did not give rise to any casualty at the site. Radiation doses received by the workers did not give rise to any deterministic effects. It can be Stated that although the TMI accident was very serious from the view point of damage to the reactor, the health consequences which arose due to it were relatively trivial.

Chernobyl Accident

On 26th April 1986 at 0123 hours, what should perhaps be the worst accident in the history of commercial Nuclear power programme occurred at Chernobyl, erstwhile Soviet Russia. The Plant involved was a 1000 MW (e) reactor of the RBMK type which is peculiar to the U.S.S.R. The brief details of the accident are as follows :

The accident occurred during a test being carried out on a turbo generator at the time of a normal scheduled shutdown of the reactor. It was intended to ascertain the ability of the Turbo generator to supply electrical energy during station blackout i.e. the short period of time until stand-by diesel generator could supply emergency power. Written test procedures that were unsatisfactory and serious violation of basic operating rules placed the reactor

at low power in cooling conditions, which could not be stabilised by manual control. Subsequently, events led to the generation of steam voids which introduced positive reactivity and resulted in an increasingly rapid rise of power. Attempts were made to stop the chain reaction but a rapid shut down was not possible because the operators, deliberately and in violation of rules, withdrew most control rods from the core and switched off some important safety systems.

Reactor power went up to few hundred times the rated power resulting in two explosions in quick succession. The rapid energy release ruptured the fuel, causing an explosion of sufficient energy to disrupt the 1000 tonne reactor cover plate. This was followed by the second explosion after 2-3 seconds which resulted in hot pieces of the reactor core and the fuel being ejected from the building causing fire in the surroundings areas. The damage to the reactor permitted the influx of air, which then caused graphite to burn. This fire raged unabated for five days before being quenched. Large amounts of radioactive materials released were carried in the form of gases and dust particles by air currents contaminating the land around the station and were widely dispersed over the territory of Soviet Union, over many other (mostly European) countries and in traces over the entire Northern hemisphere. The total activity released was estimated to

be approximately 70 MCi (megacuries) excluding noble gases. Radioactive releases from the plant continued for several days and were not stopped until 10th May, 1986. Due to release of activity in the surrounding areas of power station, approximately 1,35,000 people were evacuated and shifted to farther areas from the accident place.

203 persons were found to have acute radiation syndrome. These cases were confined to firemen and plant workers and there was none amongst the general public. Two deaths were reported to have occurred immediately following the accident. A further 29 fatalities were subsequently reported from the persons who had suffered from acute radiation syndrome.

The material cost of control, resettlement and decontamination have been enormous. Some of the people who dealt with emergency lost their lives. The accident brought forth the deficiencies in RBMK reactor design and operation procedures. The accident also provided valuable information on handling of medical and other emergency services. Experience in the treatment of acute radiation syndrome and of beta radiation skin burns has been greatly increased. On a wider scale Chernobyl also introduced the world to the actual nuclear trans-frontier pollution.

Goiania Accident

The **Goiania Accident** was an incident of radioactive contamination in central Brazil that killed 4 people and injured many others. On September 13, 1987, an old radiation source was scavenged from an abandoned hospital in Goiania, the capital of the central Brazilian State of Goias. It was subsequently handled by several people and caused serious radioactive contamination, resulting in a number of deaths.

Nature of the source

The object was a small, highly radioactive thimble of cesium chloride encased in a shielded canister. The IAEA States that the source contained 50.9 TBq (1375 Ci) of cesium-137 (half life 30 years) when it was stolen. For comparison, the average modern smoke detector contains about 37 kBq (1 μ Ci) of ^{241}Am .

(Note: 1TBq = 10^{12} Bq)

Events

When Goiania's Instituto Goiano de Radioterapia (IGR) clinic was abandoned in 1985, the cesium-137 based teletherapy equipment was left behind. On September 13, 1987, two people - Roberto dos Santos and Wagner Mota-came across the radioactive teletherapy head and took it with them in a wheelbarrow (a clear case of theft). They partly dismantled

the equipment, subjecting themselves to external gamma radiation, which caused localized burns to their bodies; one later had to have an arm amputated.

The two men attempted to further open the casing, but failed. They did, however, break the iridium window which allowed them to see the Cesium Chloride emitting a deep blue light. The light is thought to be either fluorescence or Cerenkov radiation.

The two men sold the object to a junkyard owner—Devair Alves Ferreira (radiation dosage 7.0 Gy, survived)—who intended to make a ring for his wife out of the strange and beautiful blue material.

The sale to the junkyard owner led to many more people becoming contaminated:

- a) Two of the Junkyard workers hammered open the lead casing. They died later of radiation poisoning;
- b) Devair Alves Ferreira's brother scraped dust out of the source, spreading some of it on the floor of his house. His 6-year-old daughter, was exposed to this and died a month later;
- c) Several people who visited the home came into contact with the dust and spread it around the local neighborhood and to other towns nearby; and
- d) Another brother of the junkyard

owner used the dust to paint a blue cross on his skin. He also contaminated the animals at his farm, several of which died.

The junkyard owner's wife, Maria Gabriela Ferreira (dosage 5.7 Gy), was the first to notice that many people around her had become severely sick all at the same time. Her mother came and visited her to nurse her, getting a dose of 4.3 Gy and an intake of 10 MBq (270 μ Ci). On September 25, Devair Alves Ferreira sold the scrap metal to another scrapyard.

On September 28 Maria finally suspected the scrap metal to be the cause. She took the remains of the source by bus in a plastic bag to a hospital, and the physician there rightly suspected that it was dangerous. Next day morning a visiting medical physicist used a scintillation counter to confirm the presence of radioactivity. The accident response started that evening. Maria, the wife of the scrap metal yard owner, died a month later from the effects of the radiation.

Health outcomes

a) The most contaminated people

46 people were highly contaminated and received high doses. Several

people survived high doses of radiation. This is thought in some cases to be because the dose was fractionated. Given time, the body's repair mechanisms will reverse cell damage caused by radiation.

b) Other affected persons

Afterwards, about 100,000 people were examined for radioactive contamination; 244 were found to have significant levels of radioactive material in or on their body. Of this group 129 persons had internal contamination.

Recovery considerations

The main cause of this incident was the severe negligence of the former hospital management who left behind such a dangerous item. The clean up operation was much harder for this event than it could have been because the source was opened. A sealed source need only be picked up, placed in a lead pot and transported to the radioactive waste storage. In the recovery of lost sources, the IAEA recommends careful planning and using a crane or other device to place shielding near the source to protect recovery workers.

Section 16

Responses to Accident related & other Disasters

Content

16.1.	Road, Rail and Air Accidents	419
16.2.	Fire Hazards	431
16.3.	Riots, Violence and Stampede	440

Supplementary Learning Support materials

- ★ Report: India Tops the List of Road Deaths Across the World!, *p421*
- ★ Case Study - Train Accident: Sabarmati Express, *p422*
- ★ Handout on Air Accident and Aviation Safety Tips, *p423*
- ★ Top 10 Airline Safety Tips, *p427*
- ★ Travel Tips: How to Avoid and Survive a Plane Attack, *p429*

- ★ Handout on Fire Hazards and Risk Reduction Measures, *p433*
- ★ Slide on Fire in Urban Areas – What to do, *p438*
- ★ Slide on Fire in Rural Areas – What to do, *p439*
- ★ Handout on Riots/Violence – Do’s and Don’ts, *p442*
- ★ Stampede: Do’s and Don’ts, Guidelines, *p442*
- ★ Case Study of Chamunda Devi Temple Stampede, *p443*
- ★ A Discussion on the Stampede during Puri Ratha Yatra, *p445*
- ★ Slide on Recent Stampedes in India & World, *p447*
- ★ Slide on Crowd Management in some of the Sacred Places in India, *p448*
- ★ Slide on Stampedes kill more Indians than Blasts, *p449*

Section 16

16.1. Subject/Theme:

Road, Rail and Air Accidents

PART-I

Introduction and Overview

Every year about **90,000 people in India succumb** to **rail and road accidents** and **about 70,000 major and minor accidents** occur across the country. Further, every year about 300 accidents occur on Indian railways, which operate nearly 12,000 trains and carry more than 13 million passengers every day. Experts say the rail system, with a massive workforce, does not invest enough money to improve safety infrastructure.

As regards the **road accidents** they **occur everyday**. For instance, the Mumbai-Pune express way that rivals the best in the world has also one of the highest death rates in the world. It witnesses an average of 300 deaths every year. Deaths on the Indian roads have been blamed on a numbers of factors other than just **speed**, i.e., **tyre bursts, slippery surface in monsoon, head-on collisions, lane cutting, overtaking**, etc. Preventions of accidents lie in the long term and genuine enforcement of road safety laws. Often the **recommended rudimentary test for getting a license is not carried out** properly. Most commercial vehicles running on roads in India **would not pass**

road worthiness tests and lack even basics like functioning tail-lights, working horns or reliable brakes. To achieve global standards of road safety, the country has to crack down on regular basis on drunken driving and ban vehicles that don't pass road fitness standards.

As drunken driving deaths mount worldwide, countries like Sweden have made installed **Breath-Alcohol-Ignition-Interlock Device (BAIID)**, mandatory in all new Lorries and Buses. This device finds out if the driver is drunk and immediately immobilizes the vehicles ignition system.

Strong punishments and technological safeguards are needed to reduce road accident casualties.

In the case of air accidents, there are occasional reports of **pilot negligence, mechanical failures, violation of air traffic guidelines, hijacking, skidding in tarmac, persistent fog putting flying aircrafts in danger** and above all air crash at **take off, mid air and landing** stages. Aviation Turbine Fuel (ATF) is itself highly inflammable and burns at 800 to 1500 degree Fahrenheit (426 to 815 degree Celsius), hot enough to melt structural steel. Experts say that in 2001 the twin towers of the **World Trade Centre (WTC)** didn't collapse due to the impact of explosives in the planes that rammed onto them, but because the aviation fuel from the aircrafts melted down the steel

framework of the twin towers. Since then a number of initiatives have been taken to ensure safety in air and on the ground to avoid any disaster.

Objectives

To orient the participants about the hazards of rail and road accidents, and measures required to prevent this from occurring.

Methods

Presentation cum discussion, exercises

Materials/Learning Aids

Flipchart, LCD/OHP, video clips on road/rail disaster

Duration

Two sessions

Expected Learning Outcome

Cognitive/Knowledge Related:

- a) Improved knowledge about rail and road accidents.

Competency/Skill Related:

- a) Ability to educate people and the government, road and rail authorities about safety measure, improved capacity to respond to such hazards.

Sub-themes/Key Learning Points/Issues

- a) History of road, rail, water and air disasters in India;
- b) Causes and impacts;
- c) Safety legislation measures & implementation of existing regulations & procedures;
- d) Management of transport accidents;
- e) Challenges of search and rescue operations;
- f) Emergency hospital care/medical preparedness/crisis management plans;
- g) Role of Civil Society and private sector;
- h) Building community awareness on transport safety and promotional activities;
- i) Do's and Don'ts, NDMA Guidelines for transport accidents.

Note to the Trainer/Facilitator

This is both a knowledge and practice based session. Involve road and rail safety organisations for imparting training on the issue.

Further study

Guideline for Transport Accidents, NDMA, 2007 (pg-51-54)

PART-II: Supplementary Learning Support Materials

SLS - 1

Report

India Tops the List of Road Deaths Across the World!

More than 1.3 lakh people died on Indian roads in 2007! With just 1 per cent of the world's vehicles, India manages to account for 10% of its road fatalities, up from 8% at the last count.

It is interesting to note that in the United States, which has close to 300 million people and more than 250 million vehicles, the number of deaths per 10,000 vehicles is 1.6, while in India this number, known as the road fatality rate, is as high as 14.

Although several developed nations, such as the UK and Germany, have a high number of road accidents, the fatalities from those accidents is minimised due to good medical emergency response units. For instance, in the UK, ambulance response time is set at eight minutes, while on Germany's infamous highways; facilities to request assistance are always less than a mile away. Speedy medical assistance to road accident victims

goes a long way towards minimising deaths. Timely and able intervention can also reduce the severity of injury to crash victims. Unfortunately, in India there seems to be little concept of emergency medical services.

This, combined with the police's lackadaisical attitude towards enforcing traffic laws, contributes to the extraordinarily high - and rising - figure, as does the apathetic attitude of passers-by, which stems from a desire to avoid entanglement in police and legal issues. Not only do these deaths have a high human cost, the World Bank estimates that they cost India approximately 3 per cent of its GDP.

This is high time we need to follow traffic rules stringently and work seriously on road safety measures, so that the accidents (and those unnecessary deaths) do not become a habit.

Source: **Times of India- Editorial**, 23 Oct 2008

SLS - 2

Case Study

Train Accident: Sabarmati Express

17 people (including the driver of the Sabarmati Express and his assistant) were killed and over 127 injured (10 in critical condition) when the Ahmedabad bound passenger train from Varanasi, Train No. 9168 SABARMATI EXPRESS, collided with a stationary goods train **(on the same track!** near Samlaya village in Vadodara district of Gujarat at around 03:10 Hrs (IST) on Thursday, 21 April 2005.

The train had departed Varanasi on Tuesday, 19 April afternoon at 13:45 Hrs and was only three hours away from its destination, Ahmedabad. [Samlaya is 43 kms from Godhra (last stop of the ill-fated train), 30 kms from Vadodara (next stop) and 130 kms from Ahmedabad.] {Scheduled arrival time at Ahmedabad: 21 Apr 06:20 Hrs.}

In all, seven coaches were damaged due to the mishap including three bogeys of the goods train. The damaged coaches of Sabarmati Express were mangled and the engine and two passenger coaches had jumped track and were on top of the goods train. The early morning hour and the darkness hampered the relief work in the beginning, but the railway police and the fire brigade soon took over.

Rescuers used gas cutters and drilling tools to get into the badly damaged coaches to rescue the survivors and retrieve the dead. Senior Railway officials inspecting the accident site said the number of casualties were less because the engine had taken the maximum brunt of the collision and was tossed on top of the goods train bogey. They cut open the mangled remains of the bogies to look for survivors and bodies inside. Eight ambulances were dispatched to the accident site and the injured were rushed to SSG Hospital, Vadodara.

A disaster management team was rushed from Gandhinagar. The Gujarat administration immediately swung into action, with four ministers being sent to the accident site to co-ordinate relief operations.

Mechanical & human failure may have caused accident.

The Sabarmati Express would not have met with the fatal accident had the signal maintainer or the points-man at 'B' cabin informed the station superintendent at Samlaya that the automatic signalling system had failed. Had the superintendent known, he could have informed the Ahmedabad-bound passenger train to slow down and ***the tragedy could have been averted.***

Along with the 'human error', railway officials point to a **mechanical failure** of

a bell crank lever — popularly known as the point — on the track. A point enables a train to shift tracks. Railway officials believe that the points-man tried to normalise the point manually. In circumstances where the automatic signalling system fails, the driver is asked to slow the train to a minimum speed and the signal maintainer clears the train from that malfunctioning zone by walking in front of the engine with a green flag, a procedure which was not followed, said railway officials.

However, following the signal failure, the point did not revert to its original position and took the Sabarmati Express into the loop line and Sabarmati Express rammed into the Stationary Goods train.

One of the survivors of this terrible tragedy was the guard of the goods train, Pyarelal Mina, who escaped with few injuries. According to Mina, the goods train arrived in Samlaya at 02:30 Hrs in the morning after which it stayed stationary on the loop track. The Sabarmati was expected on the main track but it came on the loop track, the result of which was the fatal accident. Mina recalls that the tail lights of the goods train was on so it would have been spotted by the crew on the oncoming train.

Source: <http://www.mapsofindia.com/maps/mapinnews/2005/sabarmati-exp-accident.html>

SLS - 3

Handout

Air Accident and Aviation Safety Tips

In recent years, with increasing reductions in airfares and increasing number of budget airlines along with increasing middleclass in our country, air travel has been increasing rapidly. It is expected to **cross 60 million per year** by 2010. As the air traffic increases so does the risk of an aviation accident. Generally, air traffic is considered to be a safe means of transportation, but when accidents do occur they often result in absolute fatalities. Smaller, less serious accidents involving private aircrafts are more frequent than people realize, because most of these airline incidents are unreported.

Causes of Plane Crashes

Aviation accident law covers both major air carrier and general aviation accidents. General aviation includes all non-commercial aircraft including small planes, large business jets, chartered flights, pleasure crafts, helicopters, and hang gliders.

The most common causes of both major carrier and general aviation accidents include:

Pilot Errors

Pilots are responsible for transporting the planes' passengers from one destination to another. Pilots have a duty to follow air safety rules that have been outlined and created to better ensure the safety of everyone on board. Or else risk an aircraft accident.

Faulty Equipment

Faulty equipment or even poorly maintained equipment can fail and cause an airplane to crash.

Violating Airport Authority Regulations

AA laws exist to protect everyone using air travel. Violations of AA regulations can endanger the safety of everybody in the air.

Structural or design problems with an aircraft.

- a) Flight service station employee negligence;
- b) Air traffic controllers' negligence;
- c) Third party's carrier selection negligence;
- d) Maintenance or repair of the aircraft or component negligence; and
- e) Fueling the aircraft negligence.

Aviation Safety Tips

The severity of injuries suffered in a serious aviation accident depends on many factors. Most people assume there isn't very much an individual can do to protect themselves. However, there are some general safety tips to follow when you travel by air.

Before the Flight

- a) Listen to the pre-flight safety briefing;
- b) Read the safety data card in the seat pocket in front of you;
- c) When in your seat, keep your seat belt on; and
- d) Identify the closest emergency exit in front and behind you, and then count the seat rows to reach those emergency exits. This will be very helpful in case of evacuation in a smoke filled airplane.

What to Wear to Reduce your Risks

- a) In the unlikely event of an airplane evacuation via escape slides, synthetic fibers can become very hot due to friction, and melt causing first, second and even third degree burns to the body and legs. The following steps should be taken when traveling to ensure passenger comfort and safety;
- b) Wear clothes made of natural fibers such as cotton, wool, denim,

and leather. These fibers offer the best protection during an airplane evacuation or fire. Synthetics such as rayon, polyester, and nylon (especially in hosiery) can melt when heated;

- c) Wear clothing that is roomy and comfortable;
- d) Wear long pants and long sleeves. Avoid wearing shorts or skirts since these types of clothes do not appropriately cover extremities; and
- e) Wear low-heeled laced or strapped shoes, boots, or tennis shoes. Shoes made of leather or canvas is preferable. High heeled shoes will have to be removed before leaving the airplane via an escape slide. This will slow your departure from the airplane and put you at risk for severe injury from possible hazards such as broken glass, or metal debris. Avoid wearing sandals for the same reasons.

Turbulence

Turbulence happens and much of it is unpredicted. And when it does happen, adults and children who are not buckled up can be seriously injured. According to the FAA, the majority of turbulence-related injuries and deaths occur when the seatbelt sign is on. The following advice

should keep you from becoming one of those statistics.

- a) Wear your seat belt at all times, turbulence is not always predictable;
- b) In non-fatal accidents, in-flight turbulence is the leading cause of injuries to airline passengers and flight attendants;
- c) Each year, approximately 58 airline passengers in the United States are injured by turbulence while not wearing their seat belts;
- d) From 1981 through December 1997, there were 342 reports of turbulence affecting major air carriers. As a result, three passengers died, 80 suffered serious injuries and 769 received minor injuries;
- e) At least two of the three fatalities involved passengers who were not wearing their seat belts while the seat belt sign was illuminated;
- f) Of the 80 passengers who were seriously injured, approximately 73 were not wearing their seat belts while the seat belt sign was illuminated; and
- g) Generally, two-thirds of turbulence-related accidents occur at or above 30,000 feet. In 1997, about half of the accidents occurred above 30,000 feet.

Emergency Evacuation

The best preparation for an emergency evacuation is to be familiar with the location of the exits, be ready to follow the commands of the flight and cabin crew, and to wear clothes that facilitate moving down an emergency slide. For example, high heeled shoes may cause the slide to rip. In the case of deployment of emergency oxygen, your first priority is to put on your own mask. If the cabin is depressurized,

you face the risk of loss of consciousness. Putting on your mask first decreases the risk of your passing out before having the opportunity to help your children or other passengers with their oxygen masks.

In the unlikely event that you are involved in an emergency situation the most important thing you can do is to remain calm and follow the directions of the flight attendants and flight crew.

SLS - 4

Handout

Top 10 Airline Safety Tips

Due to the events of 11 September 2001, there have been a variety of changes in the air travel in the U.S. and elsewhere in the world.

a) Fly on Nonstop Routings

Most accidents occur during the takeoff, climb, descent, and landing phase of flight so flying nonstop would reduce exposure to these most accident prone phases of flight.

b) Choose Larger Aircraft

Currently, aircraft with more than 30 passenger seats were all designed and certified under the strictest regulations. Also, in the unlikely event of a serious accident, larger aircraft provide a better opportunity for passenger survival.

c) Pay Attention to the Preflight Briefing

Although the information seems repetitious, the locations of the closest emergency exits may be different depending on the aircraft that you fly on and seat you are in.

d) Keep the Overhead Storage Bin Free of Heavy Articles

Overhead storage bins may not be able to hold very heavy objects during turbulence, so if you or another passenger have trouble lifting an article into the bin, have it stored elsewhere.

e) Keep Your Seat Belt Fastened While You are Seated

Keeping the belt on when you are seated provides that extra protection you might need if the plane hits unexpected turbulence.

f) Listen to the Flight Attendants

The primary reason flight attendants are on an aircraft is for safety, so if one of them asks you to do something like fasten your seat belts, do it first and ask questions later.

Top 10 Airline Safety Tips (Contd...)

g) Don't Bring Any Hazardous Material

There are rather long lists of hazardous materials that are not allowed, but common sense should tell you that you shouldn't bring gasoline, corrosives, poisonous gases, and other such items on the aircraft unless they were allowed by the airline and shipped in a proper container.

h) Let the Flight Attendant Pour Your Hot Drinks

Flight attendants are trained to handle hot drinks like coffee or tea in a crowded aisle on a moving aircraft, so allow them to pour the drink and hand it to you.

i) Don't Drink Too Much

The atmosphere in an airliner cabin is pressurized to about the same altitude as Denver, so any alcohol you consume will affect you more strongly than at sea level. Moderation is a good policy at any altitude.

j) Keep Your Wits About You

In the unlikely event that you are involved in an emergency situation such as a precautionary emergency evacuation, follow the directions of the flight attendants and flight crew and exit the aircraft as quickly as possible.

SLS - 5

Handout

Travel Tips:

How to Avoid and Survive a Plane Hijack

- a) Travel with an airline that has no or few political enemies.
- b) Do not wear Army or ex-Army clothing.
- c) Do not carry on your luggage in Army issue bags or rucksacks.
- d) If the plane is hijacked, keep quiet and don't draw attention to yourself.
- e) Observe the terrorist's activities very carefully. If you do escape, you'll be able to help secure forces.

Stay in tourist class. 'Neutral' seating in tourist class is less likely to attract attention than first class. If the terrorists wish to show their determination, they may shoot hostages, and these are likely to have been chosen from passengers who are obviously important.

- f) If kept in close quarters with a hijacker, talk about your own and his family. Making yourself a real, normal person in his eyes will be better.
- g) Don't talk politics.
- h) If you can feign symptoms of sickness and keep it up, you may be released in an interim deal.
- i) Don't wear religious or other insignia. The hijackers may not share your beliefs! No T-shirts with political slogans either!
- j) Travel in loose, comfortable clothing. If you are hijacked you'll have to keep yourself cool, clean and healthy for some time. Play mind games to keep yourself sane.
- k) Don't carry military documents on board. Pack them in your main luggage. If a hijacker finds out you're connected, you'll be singled out for rough treatment.
- l) If the aircraft you are on is hijacked the best way to stay alive is not to

How to Avoid and Survive a Plane Hijack (Contd...)

attract attention. When hijackers make their move, they are looking for opposition. Anyone who looks like they're trying to stop them is likely to be shot.

- m) Keep your eyes open, your mouth shut... and don't volunteer for anything!

Source: www.airsafe.com

16.2. Subject/Theme:

Fire Hazards

PART-I

Introduction and Overview

A sizable amount of resources in India is consumed by several types of fire-incidents in urban and rural areas as well. Fire in **forest**, in **thatched houses**, **inside the mines**, in **densely populated and highly congested markets**, during **riots and strife**, in **prolonged heat prone areas**, in running **trains and vehicles**, in **ammunition godowns**, in **theatres and cinema halls**, during **earthquakes, lightning, accidents**, during **festivals of lights** and **marriages** and **public/social functions**, cause huge loss of property and lives.

A Forest Survey of India (FSI) estimate says that every day timber worth Rs 35 crore is lost in fire in 63 million hectares of Indian forest. The same FSI data shows that 50 percent of Indian forests are fire prone.

Recently a fire alert system has been developed by NASA as an effective tool in saving wild life and biodiversity from forest fires called "**Fire Alert and Message (FAM)**". A combination of satellite based detection of fire and computer programme, it sends an alert to the nearest forest official reducing the reaction time by

several hours. The system processes remote sensing data of active fire locations obtained through a satellite and then sends alert through SMSs and email from the nearest beat guard to the States Chief Conservator of Forests. The system also builds a database of fire locations, which can be used to identify fire-sensitive zones scientifically and also to plan fire control strategies.

However, the best way to fight fire hazards is through prevention, precaution and public awareness.

Objectives

To orient the participants about the fire hazard and measures to prevent this from occurring.

Methods

Presentation cum discussion, exercises

Materials/Learning Aids

Flipchart, LCD/OHP, video clips on road/rail disaster

Duration

One session

Expected Learning Outcome

Cognitive/Knowledge related:

- a) Improved knowledge about fire hazards; and
- b) Causes and prevention methods.

Skill/ Competency related:

- a) Ability to educate people about fire related disasters and ways to prevent and overcome fire hazards;
- b) Undertake rescue and relief operations;
- c) Train people on how to respond to fire hazards;
- d) Skills of self protection while rescuing the victims; and
- e) Ability to identify fire prone areas and sources.
- c) Effects of fire hazards;
- d) Areas vulnerable to fire;
- e) Loss of property, loss of life, how to avoid/minimise it;
- f) Community preparedness against fire;
- g) Prevention, mitigation & preparedness measures; and
- h) Do's and Don'ts about fire hazards.

**Sub-theme/key learning points/
Issues**

- a) Various factors and causes of fire;
- b) Types of fire and its characteristics;

**Supplementary Learning Support
Material**

Handouts, slides

Note for the Trainer/Facilitator

Organize a mock drill on Fire hazards

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Fire Hazards and Risk Reduction Measures

Hazards

Fire is an essential component of human life. We cannot imagine a world without fire as **human existence or survival is not possible minus fire**. Fire facilitates in providing comfortable human lifestyle if used properly. And if the same fire is misused and neglected it can even end the human existence.

Crowded places such as - large hotels,

cinema halls, circus, religious gatherings, large fairs and political rallies are particularly vulnerable because of very large gathering of people. Loose or temporary wiring, overloaded electrical equipment, highly combustible materials like tents, shamianas, thatched roof, plastic sheeting and seats, and above all **shortage of adequate number of exits** are responsible for fire mishaps in such places. Celebrations like Diwali, festival of lights and fire crackers can turn into a nightmare if appropriate precautions are not considered.

Fire Risk Reduction Measures

BEFORE

Do's

- a) Identify fire prone areas, situations, sources, surroundings.
- b) Form task force responsible for fire fighting in fire prone communities.
- c) Keep all the emergency telephone numbers (fire station, ambulance, police station, Red Cross Volunteer) handy in your house.
- d) Develop effective warning system and disseminate to the community and family members.
- e) Throw away cigarettes and bidis butts only after extinguishing them properly.
- f) Ensure that proper wiring is done in the house and use standard electrical equipment and if required, change the old electrical circuits.

BEFORE (Contd...)

- g) Turn off the electric equipment after its usage.
- h) Store all the inflammable items like kerosene, petrol in a safe place and away from the fire area.
- i) If possible, locate water/pond or well near the house and plant trees.
- j) Keep ropes, jute bags, shovels, digging tools and spade ready within reach which can be of a great help in response, if the fire breaks out.
- k) Organize regular mock fire drill in the community so that people are aware of the escape route and also the evacuation method.
- l) Always make sure that the road leading your house or the community is wide enough for the fire tenders to arrive on time during any emergencies.
- m) As a community member, take first aid training and be a part of the community First Aid group to provide first aid or to transfer the serious case to nearby hospitals during disaster time which can save lives.
- n) Get yourself aware of the fire hazards, safety and precaution measures, evacuation and also the relief and response methods and disseminate to the community members to reduce the fire risk and to save maximum lives if disaster occurs.
- o) Always remember, to go inside the burning house for rescue, always put on wet clothes, gunny bag, use ropes and one should enter the house by keeping the body as close to the floor as possible to avoid the smoke.

BEFORE (Contd...)

Don'ts

- a) Do not keep the cooking gas cylinder inside the house, where possible.
- b) Do not use unauthorised electrical lines and supply.
- c) Do not leave open fire like candles or cooking stove unattended. Extinguish the fire immediately after its usage and also keep away from infants/ children.

BEFORE (Contd...)

- d) Do not forget to mark the emergency exit points clearly and make sure the emergency evacuation passage is clear at all times. (In buildings in urban areas).
- e) If possible, do not build houses too closely, so that if one house catches fire, there will be less danger of spreading it easily in the community.
- f) In villages, avoid using roofs with thatch and grass and also the plastic sheeting which could increase the intensity of the fire, if it takes place.

DURING:

Do's

- a) The first thing to remember is not to panic, be calm and act smartly which can save maximum lives and reduce the casualties.
- b) Immediately cut off the electricity, gas and water supply.
- c) Immediately call up the fire brigade and tell them the exact address of your house or community and also the type and intensity of the fire, if possible, so that they are well equipped when they arrive for the response.
- d) Issue the warning signal and evacuate the house immediately.
- e) If the smoke is too much, crawl and keep yourself as low as possible during evacuation.
- f) If you see your neighbour's house burning which happens to be locked at that time, immediately try to inform them and convey the message without panicking. And, if you have already informed the fire brigade, also assure them that the fire tenders are on their way.
- g) If you are a trained Red Cross Volunteer, immediately give First Aid to the casualties and if required, transfer them to the nearest hospital.

DURING: (Contd...)

Don'ts

- a) Do not allow a person whose clothes or body is in fire to run around. Immediately cover him with rugs and do not pour water on him.
- b) In panic, do not enter the burning house to pull out the trapped family members or other community members without wearing proper fire proof clothes or material.

AFTER:

- a) In fire hazards **immediate care** is needed.
- b) **If trained in First aid**, provide first aid to the casualties and also the psychosocial care.
- c) **Identify the cause of the fire** and rectify it immediately.
- d) Be very careful and develop sufficient **precautionary methods** and adopt it strictly to reduce the future risk.
- e) If possible, **insure your house and property**.
- f) Store all your **valuables and important documents** in a **safer place**.
- g) While building a house, follow the construction rules and use **fire resistant** or **fire retardant material**.
- h) Do not allow inflammable material pile up unnecessarily and stock them in a safe place as per the recommended safety procedure.
- i) Adopt **fire proof practices** at your household level such as, your own house - specially in the kitchen; and at the work place such as, factories, coal mines, oil stores and chemical plants.
- j) **Fire sensors** and **smoke detectors** to be installed in multi-storeyed buildings. (Urban areas)
- k) **Store** adequate water and fire fighting material and equipment.
- l) Keep all electrical equipments **earthed properly** and ensure their **regular maintenance**.

AFTER: (Contd...)

- m) Arrange **regular fire drills** in the community and **volunteer** to participate.
- n) **Educate yourself** on fire hazards, prevention and precautionary measures and increase awareness in the community.
- o) **Organize fire drill** in the community and encourage your family and community members to participate.
- p) **Timely taken precautionary measures** can save lives, property and reduce risk in the community.

Source: Indian Red Cross Society, Training of trainers Hand Book for community based disaster management

SLS - 2

Slide

Fire in Urban Areas – What to Do ?

- a) In urban areas there are more inflammable materials.
- b) If possible, try to extinguish the fire using the chemicals: fire extinguishing powder or gas etc. (for urban areas)
- c) If possible, immediately throw away or move out all the inflammable items (kerosene, petrol, gas cylinder etc.) out of the house to reduce the fire intensity.
- d) While evacuating the room, try to evacuate by crawling because most of the time the deaths occurs due to the inhalation of the toxic gas and not with the burns.
- e) Do not use lift while evacuating the building. **Always use the staircase.**
- f) **Do not panic and jump from the tall buildings**, try to come near the window or a terrace and ask for help from the fire tenders.

SLS - 3

Slide

In rural there are numerous fire accidents, mostly during summer months. Rural households have thatched roofs, hay stalks, in-house granaries, wooden farm equipments and firewood in the courtyard – all quite volatile to fire. Even today a majority of rural households depend on wood and coal for cooking. On the top of that, government fire services have scarce presence in rural areas, which makes the scene even worse. Fire affects rural people more than others because it completely ruins the poor households. Insurance is a joke in such areas!

Fire in Rural Areas

What to do?

- a) Immediately separate the part of the house that is not burning. For example, in plain and hilly regions, one should try to remove the part of the roof that is not burning.
- b) Use locally available materials that are helpful in extinguishing fire.
- c) Much effort is necessary for extinguishing a forest fire. It is a difficult task because the fire spreads quickly and if the wind is blowing, the effect of a fire becomes greater.
- d) In the case of forest fire, immediately evacuate that area completely.
- e) In the case of coal mines, always make sure that the exit passage is clear at all times.

16.3. Subject/Theme:

Riots, Violence and Stampede

PART-I

Introduction and Overview

Riot and violence are recurrent incidents in India trying to destroy unity in diversity.

A riot is a complex civil disaster composed of a wide variety of goal directed activities. Some of these are **anti-social** when people work together to **disregard law and order** and resort to loot, plunder, violence, arson and force others to close shops, business, transport, etc. Criminal law defines riots as **“mobs, mob action, unlawful assembly which specifies gathering of three or more people with a clear intent of violence, to terrorise and distort peace and achieve their ant-social intent.”**

Riots and consequent violence have been further divided into four categories, i.e. **communal, commodity, protest and celebration.** Communal riot is a collective violence between opposing racial or religious groups, commodity riot is primarily directed at buildings, markets and equipment/facilities of another group. In “Protest Riot”, violence focuses on specific government policy, i.e., increased prices of petrol, gas, bus/train tickets, etc. Some political parties give a call for “Bundh” to stop all normal activities in order

to register the protest. In the fourth type – “Celebration”, violence is not directed at any particular group or category. It usually happens when people celebrate a victory or take out religious processions.

More research is needed on riot assembly processes, riot area activities, riot dispersal processes. Pro-social people also need to be sensitized on the issue at individual, organisational, community and societal level. Riots, conflicts, terrorism confront organisational decision makers with a threatening situation that requires urgent decision making under conditions of uncertainty.

Unlike riots and violence, stampede is an act of mass impulse in which large numbers of assembled people run without clear purpose or direction. Collective panic in large gatherings leads to irrational behaviour.

Objective

- a) Enhance participants’ understanding of riot, violence, social conflicts, stampede, terrorism, etc.; and
- b) Improve capacity for crisis analysis, decision making to face riot situation.

Methods

Presentation cum discussion, brain storming, role play

Material/Learning Aids

LCD/OHP, Flip chart, white/black board with marker, sheets of paper

Duration

One session (Refer page no. 243).

Expected Learning Outcome

Cognitive/Knowledge Related:

- a) Better understanding of the social, cultural, economic and political factors behind riot, violence and stamped

Competency/Skill related:

- a) Ability to identify the reason and source of violence and develop appropriate programme response, negotiation and conflict resolution mass management skills

Sub-themes/ Key Learning points/ Issues

- a) Defining riot, violence and stampede;
- b) Its types, causes and consequences;
- c) Criminal laws related to riot – how to use it;

- d) Understanding mob mind, intent;
- e) How to control a crowd to regulate mob and mob action;
- f) How to strengthen restraining process, involve community and social groups;
- g) Promoting calm, care for the injured, traumatized, emotionally damaged, police-civilian contacts;
- h) Basic communication skills to eliminate the negative impact of rumours, mis-communication, conflict resolution and peace building;
- i) Pre-riot warning, avoid being caught unprepared decision making; and
- j) Disaster relief for riot, violence, stampede affected.

Note to the Facilitator

Use creatively training method like role play, simulation games, workshop and laboratory, fish-bowl and free group discussion. Emphasize the disaster context and consequences of human behaviour, also present one or two case studies on the issue.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Riots/Violence - Do's and Don'ts

In order to avoid riots and violence in the community and to build a strong community network; and also, once the riots/violence has occurred, to reduce the risk and damage to humans and property, the community members must:

- a) Take down all the emergency phone numbers of **police, fire brigade, Red Cross Volunteers** trained in First Aid, **Psychological support, health**, etc., so that if in case you come to know that the violence or riots have flared up in the community, you can contact them for immediate community level intervention before the arrival of external aid;
- b) As a community member, **do undertake First Aid and psychological training;**
- c) **Develop communal harmony** through co-operation within the community;
- d) Also try to **develop goodwill** among the community members who does not belong to your social group;
- e) If tension areas are identified, **avoid visiting those areas** unless you have some work;

- f) Do not **involve yourself in discussion/debate of controversial subjects or topics** that might create communal misunderstanding and may lead to riots/violence; and
- g) At your household level, inculcate among children and elders the culture of respecting cultures and customs of other community members and consider them as your brothers and sisters.

SLS - 2

Handout

Stampedes: Do's and Don'ts, Guidelines

- a) Stampedes are defined as acts of mass impulse in which large number of assembled people run without clear purpose or direction;
- b) Such collective panic triggers irrational behaviour;
- c) In India most of the stampedes occur at religious places, mass public meetings, festivals and processions;
- d) The worst stampedes in recent history happened in 2005 at the Mandardevi Temple in Wai, Maharashtra that killed 300 people;

- e) The most recent stampede occurred in July 2008 at Naina devi shrine that killed 150 pilgrims;
- f) The year 2008 witnessed a series of stampede at Sabarimala , Rath Yatra in Puri and a remote village in Madhya Pradesh killing 100 people;
- g) To avoid stampede touch and comprehensive crowd management mechanisms should be in place;
- h) Absence of crowd control measures crushed pilgrims in Puri Car festival when too many people tried to be too close to the chariot;
- i) At Naina Devi, rumours of a land slide causing of people by police as a crowd control measure precipitated the crisis;
- j) Stampedes can be avoided by simple, commonsense strategies aimed at averting the build up of critical crowd densities that triggers rapid group movement;
- k) In Vaishno Devi , Golden Temple and Tirupati models slips are issued and sewadars are engaged to limit the number of pilgrims who can visit or enter a temple at any time;
- l) Having fewer people in a vulnerable locations considerably reduces risk of stampedes; and
- m) A set of supplementary measures can help in avoiding such mishaps
These include:
 - i) Delineating clear entry and exit routs;
 - ii) Maintaining a strict visit vigil on the flow of people;
 - iii) Installing an effective public address system to quell panic;
 - iv) Deploying enough police personnel to monitor and control crowd movement;
 - v) Placing volunteers at weak points for prevention and rescue; and
 - vi) Educating people / pilgrims to avoid safety hazards.

SLS – 3

Case Study

Chamunda Devi Temple Stampede

The Incident

A human stampede occurred on September 30, 2008, at the Chamunda Devi temple in Jodhpur, Rajasthan, India, in which 249 people were killed and more than 400 injured. The 15th-century temple is dedicated to the goddess Chamunda Devi and is located within the premises of Mehrangarh Fort*.

About 25,000 Hindu pilgrims were visiting the temple to mark the first day of the nine day long Navratri, a major festival in Hinduism dedicated to Goddess worship and celebrated across the world.

The Cause

The devotees scrambled towards the door the moment it opened, resulting in the destruction of the barricades. Many people were injured when they lost their footing on the slope approaching the temple.

According to The Times of India, local

reports suggest that a bomb blast in nearby Mehrangarh created panic among the pilgrims resulting in the stampede. However, the BBC News reported that a collapsing wall may have also caused the stampede. Some eyewitnesses told CNN-IBN that a rumor about a bomb being planted in the temple caused panic among pilgrims.

Others said there was a scramble in the men's queue; some devotees slipped and soon there was a massive resultant stampede where a day of celebration turned into one of mourning.

An eyewitness also said that the path leading to the temple was very narrow with no emergency exit routes. District collector Naresh Pal Gangwar said "There was a ramp and that collapsed, and people slipped causing chaos and suffocation."

Aftermath

Television footage showed frantic people trying to revive unconscious devotees by compressing their chests. The Divisional Commissioner for Jodhpur said that of those dead, 30 bodies were brought to Mahatma Gandhi Hospital and 10 were

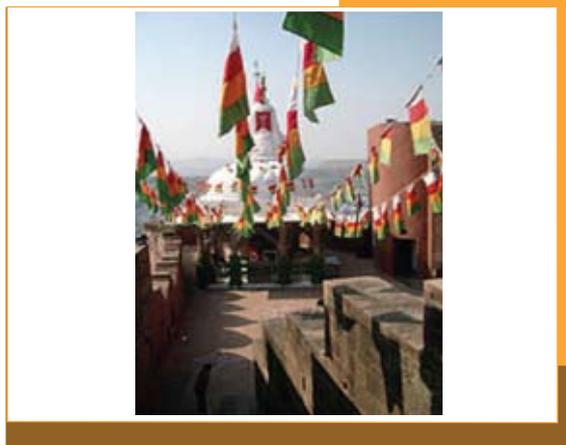
taken to Mathura Das Hospital. Later on, more than 400 injured devotees were admitted in seven hospitals across Jodhpur. According to reports, there is a shortage of oxygen in local hospitals where the victims are being treated.

Indian Army doctors were also called to assist the local authorities in the relief operation.

Local authorities revealed that most of the dead were men as the queue for women was separate.

Criticism

Media reports said the authorities were ill-prepared, while claiming the crowd was "simply too much." They also said there was no medical help for the injured. One eyewitness was quoted as saying "There was a lot of crowd and a steep slope. Some people slipped and everyone else lost balance and [then] there was a stampede." Another said, "We carried them (the victims) ourselves, there was no other help, and vehicles couldn't come in."



Chamunda Devi Temple

**Chamunda Mata temple is situated at the Southern gate of Mahendragarh fort in Jodhpur, Rajasthan. The fort has witnessed this second major accident. The first was on August 9, 1857, 300 people were killed after lightning struck the ammunition depot in the fort.*

SLS – 4

Case Study

A Discussion on the Stamped during Puri Rath Yatra

On the 4th of June 2008, in Puri, Odisha the Car Festival ('Rath Yatra'), started, bringing rays of hope to the devotees across the world, amassed in the 'Bada Danda' (the wide path of the Yatra), waiting for celestial darshan (glimpse) of Lord Jagannath, Balabhadra and Devi Subhadra.

Little did they know that it would be an unforgettable cursed event of their lives.

It all happened when overwhelmed pilgrims went berserk and pushed themselves around the chariots to have a look of their deities. The police tried to keep them off the chariots, which resulted in a deadly stampede. It killed 6 persons and many were injured. Also, many more, mostly aged and children got lost in the crowd. The police did not have any record of the missing persons; neither did the local administration nor even the concerned volunteers/agencies. This was not the

first time the unwanted stampede caused such disaster. Last year too there was some causality due to stampede. In fact stampedes during Rathyatra are regular phenomena, killing/injuring devotees year after year. Instead of having pleasant times, many are forced to carry the dead/injured back to their homes, or search for their missing dear ones.

It is a clear reflection of ineffective & inadequate preparedness; lack of alternative strategy to handle the crowd; unorganized volunteer management; inefficient planning, networking and coordination among stakeholders as well as indifferent attitude of police, administrators and NGO volunteers.

The post disaster situation of 4th June was even more painful. The district hospital of Puri town was overcrowded with injured and their relatives, who were wandering either for immediate medical help, or for information regarding their kith and kin. There was no helpline at the hospital campus. There was no one to give even a line of emotional nurture to the bereaved pilgrims. A number of women and elderly could be seen helplessly trying to get information about their relatives/guardians.

This is high time that we should consider certain do's and don'ts before next Ratha Yatra:

- a) Volunteers management should be more structured and organized;
- b) Networking and coordination among

- all the agencies; both Govt., non-govt., police, district and local administrators should be better planned;
- c) Roles and responsibilities of each and every stake holders or volunteers per say, must be clearly defined;
- d) Care should be taken that responsibilities should be distributed equally so that no one gets overburdened and commits or omits his/her duty;
- e) Allocation of space for the common pilgrims and V.V.I.P.s should be done justifiably;
- f) Help lines must be established at various laces, which could help the pilgrims as well as enhance networking;
- g) Doctors/paramedics/volunteers should be asked/trained to give physical and emotional support to distressed, specially to women, aged, child and differently abled persons;
- h) Information and instructions should be displayed at all the Bus stations, railway stations, airport terminals; and
- i) Most of all, the concerned persons should make themselves a promise to administer a disaster-free Rath Yatra in coming years.

SLS – 5

Slide

Timeline: Recent Stampedes in India & the World	
India	World
<p>September 30, 2008: 249 died in the Chamunda Devi temple stampede out of over 10,000 devotees, mostly youngsters, who had queued up for Darsan in the congested 8 feet pathway.</p> <p>August 10, 2008: Two pilgrims died when over 250 people were left stranded on stairs leading to ancient Mahadeva temple in Kota district of north-western Rajasthan collapsed</p> <p>August 3, 2008: 162 dead while 47 are injured in a stampede triggered by rumours of a rockslide at Naina Devi Temple in Himachal Pradesh.</p> <p>June 4, 2008: 6 persons were killed and numerous injured in the stampede during Puri 'Rath Yatra' in Odisha. Several pilgrims, mostly aged and children went missing.</p> <p>March 7, 2006: 28 killed and 101 injured in two bombings across Varanasi. First blast at a Varanasi temple followed by another at the Cantonment Railway Station crowded with pilgrims.</p> <p>January 25, 2005: 340 devotees trampled to death during an annual pilgrimage at Mandhra Devi temple in Maharashtra. where an estimated 300,000 people had gathered for a religious festival.</p> <p>August 27, 2003: 39 pilgrims killed, 125 injured when faithfuls who were waiting to bathe surged over a flimsy fence triggering a stampede at Kumbh Mela bathing festival in Nasik, Maharashtra.</p> <p>April 13, 2000: 28 people electrocuted when an 11,000-volt electric cable snaps and falls on a crowd of singing and dancing Hindu devotees during a midnight chariot procession in the town of Daltoongunj in eastern India.</p> <p>Jan 15, 1999: At least 51 pilgrims killed and 100 others injured in a stampede and landslide at a Hindu shrine as thousands of people rush down a hill near the Sabarimala shrine in southern Kerala State.</p> <p>June 7, 1997: At least 39 people killed and 88 injured when a fire, sparked by firecrackers, sweeps through a Hindu religious gathering at a tent near a 1,000-year-old temple in the town of Thanjavur in southern India.</p>	<p>12 January 2006, Mina, Saudi Arabia: At least 364 die in a crush during the annual Hajj pilgrimage to Mecca. The stampede happened after pieces of luggage spilled from moving buses in front of one of the entrances to the bridge of Jamarat, causing pilgrims to trip.</p> <p>31 August 2005, Baghdad, Iraq: Up to 1,000 Shia pilgrims are trampled to death or drown in the Tigris river after rumours of a suicide bombing sparked panic. Many of the dead are women and children.</p> <p>1 February 2004, Mina, Saudi Arabia: Some 251 pilgrims are trampled to death in a 27-minute stampede during the Hajj. Many of the victims were not authorised to participate in the Stoning of Satan ritual, after new procedures were introduced following previous stampedes.</p> <p>9 May 2001, Accra, Ghana: Some 126 die in a stampede following a football match at the Accra Sports Stadium. The Ghanaian police are blamed by many survivors for causing the stampede by firing tear gas in the packed and locked stadium, after angry demonstrations by fans of the losing side.</p> <p>9 April 1998, Mina, Saudi Arabia: At least 118 pilgrims die and more than 180 are hurt during the Stoning of Satan ritual. The pilgrims, mostly from Indonesia and Malaysia, are trampled to death after panic erupts when several people fall off an overpass.</p> <p>2 July 1990, Saudi Arabia: Some 1,426 pilgrims, mainly Asian, die in a huge crush in a tunnel leading to Mecca's holy sites. Most died of asphyxiation after the tunnel's ventilation system broke down.</p> <p>15 April 1989, Sheffield, England: Some 96 Liverpool supporters are crushed to death during the FA Cup semi-final between Liverpool and Nottingham Forest. Police had opened the doors at one entrance to Hillsborough Stadium to allow about 2,000 people without tickets to enter the stadium, crushing others in the stands.</p>

SLS – 6

Slide

Section 16

Crowd Management in some of the Sacred Places in India

CROWD CONTROL

Even as most places remain poorly managed, some shrines avoid disasters by using CCTVs, volunteer, police and scouts for a better traffic flow. These shrines show how easy it is to make the places of worship safe for devotees by some careful planning

TIRUPATI / Andhra Pradesh

Volume of devotees

60 -80,000

pilgrims everyday

Crowd

Management

- Crowd segregated at 2 herding spots
- Proper resting places for pilgrims to avoid crowding on the hill.
- A huge team led by the deputy executive officer and assisted by more than 250 officials control & guide devotees
- No major disaster ever



SHRAVANABELAGOLA / Karnataka

Volume of devotees

more than **25** lakh during week long Mahamastakabhisheka held once in 12 years

Crowd management

- Permanent barricades on either side of the steps
- Separate paths for entry and exit
- Thousands of volunteers to guide and control the crowd
- Thousands of police personnel with proper training
- Passes given to all visitors during the event
- No stampede ever



GOLDEN TEMPLE / Punjab

Volume of devotees

100,000 per day, On

Saturday & Sunday the figure goes upto **2.5** lakh to **2.75** lakh

Crowd

Management

- People allowed in the batches of 30 to 40 devotees at a time to enter the sanctum sanctorum
- Barricades for managing the crowd
- Sewadars deployed to keep a watch on the crowds
- No stampedes ever



KAMAKHYA TEMPLE / Assam

Volume of devotees

3,000 on a normal day. During the mugh (Feb-Mar), the number goes up to **10,000** per day. During Ambubachi festival in June, **800,000** devotees visit in a span of 4-5 days

Crowd Management

- On rush days, volunteers, boy scouts and girl guides help the devotees
- Fences along the path to ensure that queues not broken
- Local police and homeguards to keep a watch on the crowds
- No major disaster



SOMNATH/ Gujarat

Volume of devotees

30 lakh round the year.

200,000 visit the temple on Shivratri

Crowd management

- People staggered through phases & segregated in queues
- People not allowed to gather at one place
- People jumping the queue sent back to the end of the line
- No stampede ever



AJMER SHARIF/ Rajasthan

Volume of devotees

10 -12,000 visit everyday, **4-5** lakh people everyday during the Urs period

Crowd Management

- During Urs and Moharram, special magistrates take care of law and order
- Barricades installed during the Urs
- Pilgrims allowed to enter the mazar on a rotation basis
- Night entry into the dargah not allowed
- One gate for entry, two for exit
- 6 people died of suffocation in 1989



Source: Times of India, October 1, 2008

SLS - 7

Slide

Stampedes kill more Indians than Blasts

- a) In 2008 alone, over 360 people have lost their lives in stampedes compared to 156 in bomb blasts
- b) In the last 9 years, 875 people died in stampedes to 766 killed by terrorist bombs
- c) 257 people died in 1993 Mumbai blasts, considered to be an unusually high toll. But a stampede in Satara district in 2005 killed 340 while a recent one at Himachal's Naina Devi shrine killed 162
- d) Six lives were lost in a stampede in Puri Jagannath temple in July 2008 even before a committee setup to probe an earlier one in 2006 could submit its report

Source: Times of India, October 1, 2008

Section 16

Section 17

Responses to Biological Disasters

Content

17.1.	Epidemics (Cholera, Malaria, T.B, HIV/AIDS, Bird Flu, etc.)	453
17.2.	Agricultural Epidemics	466

Supplementary Learning Support materials

- ★ Handout on Pest Attacks, *p468*
- ★ Handout on Cattle Epidemics, *p456*
- ★ How to Prevent Food Poisoning during Disasters, *p456*
- ★ Handout on Biological Warfare Agents: Past and Present, *p457*
- ★ Handout on Environmental Management, *p460*
- ★ Handout: Disposal of Animal Carcasses – A Prototype, *p461*
- ★ Handout on Patient Isolation Precautions, *p464*

Section 17

17.1. Subject/Theme:

Epidemics

PART-I

Introduction and Overview

Biological disasters of natural origin are largely the **result of the entry of a virulent organism into a congregation of susceptible people living in a manner suited to the spread of the infection.** For instance, in crowded areas anthrax spreads by spores dispersal in the air, small pox spreads by aerosols, typhus and plague through lice, fleas, rodents etc. **Epidemic comes under biological disasters, the third type of disaster after natural and human induced ones.** An **epidemic** is defined as the **occurrence of a particular disease in excess of the expected, demanding emergency control measures.** It occurs when the equilibrium between a given population's susceptibility (host), the virulence of the infections agent (**bacteria, viruses, parasites, fungi, etc.**) and the environment that promotes the exposure, is upset. Spread of illness is also **connected to** our earth system. Cyclone, flood, earthquake, drought and weather hazards raise an array of public health concerns. Climate researchers now say that outbreak of diseases like cholera in India occurs depending on the temperature of the Bay of Bengal. Change in vegetarian and moisture can now help

forecast outbreak of malaria. The key is, bringing the relevant **data together** related to health, weather, human behaviour, disasters and others.

The main causes of illness and death during the acute emergency phase are - **acute respiratory infections, measles, diarrhoeal diseases, malaria, dengue, tuberculosis, meningitis.** In addition to these, epidemics also cover communicable diseases i.e. - **avian flue, plague, jaundice, hepatitis, typhoid and yellow fever, STDs and HIV/AIDS.** The average epidemics spread locally and die down if the contagion is localized. It can also spread widely and across National boundaries and attain pandemic form.

Objectives

To sensitise trainees on various aspects of epidemics, ways to prevent and control them, role of civil defence functionaries and volunteers in meeting and mitigating this challenge.

Methods

Technical, lecture-cum-discussion, group-work, interactive sessions, participatory incident method, simulation exercises, decision making games, quiz, practical and field visits.

Materials/Learning Aids

Audiovisuals, OHP/LCD, white board/black board, flip charts, sheets of paper, materials for first aid, etc.

Duration

Four sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/knowledge based:

- a) Knowledge of history of epidemics in India, various aspects of epidemics, its causes, consequences, how it spreads, prevention, control measures, etc.

Competency/skill based:

- a) Ability to anticipate/predict epidemics;
- b) Give early warning based on available data;
- c) Analyse vulnerability, undertake/advise mitigation, preventive and preparedness measures; and
- d) Skills in coordination, surveillance, control strategies, rescue, recovery operations, community mobilization, first aid, water sanitation, etc.

Sub-themes/discussion points

- a) What is a biological disaster?;
- b) Biological agents as causes of mass destruction;
- c) Epidemics as a form of biological disaster;
- d) Indian experience of Epidemics;
- e) Disaster-epidemic connection and likely diseases during emergency situation;

- f) Agent-Host- environment, medium of infection;
- g) Causes, characteristics, effects, vulnerability;
- h) Legal framework, institutional and operational framework;
- i) Epidemic thresholds, role of surveillance, bio-safety laboratories;
- j) Mitigation measures;
- k) Preventive measures, risk communication and role of media;
- l) Preparedness measures for various epidemics;
- m) Control strategies, guidelines for safety and security of microbial agents, livestock;
- n) Emergency medical and public health response;
- o) Need for international cooperation;
- p) Rescue, recovery and Rehabilitation;
- q) Training and capacity building for managing the pandemic;
- r) Community mobilisation, command, control and coordination; and
- s) Do's and don'ts - before, during, and after the epidemic.

Supplementary Learning Support

- a) Handouts on Epidemics, pest attacks, cattle epidemics, food poisoning, biological warfare;

- b) List of Do's and Don'ts;
- c) Slides; and
- d) Mitigation and prevention measures-
Reference material.

Activity

A quiz can be organized to assess participant's understanding of various aspects of the biological disasters including epidemics.

Further Study/References

- a) **Management of biological disasters, NDMA, GOI, 2008**

- b) **Websites: www.who.int; www.nicd.org; www.ivri.nic.in; www.ndma.gov.in; www.mohfw.nic.in**

Note for the Trainer/Facilitator

This is a highly technical session and needs to be handled by experts who could connect the epidemics to the disaster context.

PART-II: Supplementary Learning Support Materials

SLS - 1

Handout

Cattle Epidemics

The movement of highly contagious animal diseases, including foot-and-mouth, poses a serious threat to central and south Asia region. India has a very large cattle population that helps milk production and agricultural operations. Therefore cattle epidemics can destabilize its economy.

South Asia including India remains more susceptible to trans-boundary animal diseases, because measures to prevent viruses from spreading are weak. Such diseases have the potential to emerge as a disaster. Foot-and-mouth, which is transported via droplets from the breath, causes blisters in the mouth and teats, lameness, secondary infections and loss of claws and hooves. Young lambs, pigs, kids and calves are particularly susceptible to the virus, which wipes out the heart muscle.

SLS - 2

Handout

How to Prevent Food Poisoning during Disasters

Tips to Make Kitchens Food-Safe

- a) Food poisoning creates a disaster within disaster;
- b) With the invention of refrigerators, people have grown rather careless about storing their foodstuff. It's a common assumption that once the food goes inside the fridge it's safely stored for a long time! As a result, the number of food poisoning cases is on the rise globally;
- c) In order to avoid a food poisoning disaster in your home, you ought to develop certain safe food storing and food handling practices in your kitchen;
- d) Meat, poultry, seafood and other animal-derived protein-rich foods are the ones one has to be most careful about. The bacteria from the animals sometimes still remain in their meat, and the meat stored or handled improperly in unhygienic conditions helps these bacteria to flourish and thrive;
- e) While shopping, keep the meat, poultry and seafood separated from the other foodstuffs in your cart. Follow the same practice while storing them in the refrigerator or handling them in the kitchen;
- f) Never forget to wash hands, cutting boards, dishes, and utensils with soap

- and hot water both before and after they are in contact with raw meat, poultry, or seafood. If possible, use separate cutting boards for animal products and other non-animal/seafood products;
- g) Always place cooked food on a plate/dish that you know is absolutely clean. A great number of food-poisoning disasters stem from apparently clean-looking plates/dishes that were actually contaminated by raw animal food/seafood that were placed on them before;
 - h) Always cook animal food, seafood at the recommended temperature and for the right duration as required to completely kill any thriving toxic bacteria. The danger zone is between 32° and 140° Fahrenheit, which is the range in which bacteria thrive and multiply;
 - i) Either freeze your food or keep it warm in the oven. Food left out at room temperature for more than an hour should be discarded right away!;
 - j) Beware of the colours blue and green in your food. Layers of these colours usually indicate the formation of deadly fungus. Cheese, cream and most other dairy stuffs are most likely and easily vulnerable to catch these harmful fungi;
 - k) Avoid puffed, bloated or leaky cans of food. Food cans are puffed up when harmful microbes working inside produce enough poisonous gases to swell the container. Deadly food poisoning attacks like botulism may result if you consume from such cans; and
 - l) Some raw vegetables carry larvae of dangerous worms. While it might be tempting to munch on raw celery or fresh carrots, experts will insist on first washing them in a solution of water and some safe-to-eat disinfectant, like potassium permanganate before serving those colourful salads...

Source: www.ezilon.com/information/article_15226.shtml

SLS - 3

Handout

Biological Warfare Agents: Past and Present

Human history is replete with misuse of biological agents for causing disasters. **Biological weapons include any organism or toxin found in nature that can be used to incapacitate, kill, or otherwise impede an adversary.** Biological weapons are characterized by **low visibility, high potency, substantial accessibility,** and relatively **easy delivery.**

The use of biological agents in war and conflicts is not a new concept, and history is replete with examples of biological weapon use. Before the 20th century, biological warfare took on 3 main forms:

- a) Deliberate poisoning of food and water with infectious material,
- b) Use of micro organisms or toxins in some form of weapon system, and
- c) Use of biologically inoculated fabrics.

Attempts to use Biological Weapons date back to antiquity. Scythian archers infected their arrows by dipping them in decomposing bodies or in blood mixed with manure as far back as 400 B.C.

Persian, Greek, and Roman literature from 300 BC quote examples of the use of animal cadavers to contaminate wells and other sources of water. In 190 BC, at the Battle of Eurymedon, Hannibal won a naval victory over King Eumenes II of Pergamon by firing earthen vessels full of venomous snakes into the enemy ships. In Ramayan and Mohabharat snake-weapons were being used to defeat the adversary.

In the 18th century AD during the French and Red Indian War, British forces in North America gave blankets from smallpox patients to the Native Americans to create a transmission of the disease to the immunologically naïve tribes.

In 1863, a doctor was arrested and charged with trying to import yellow fever-infected clothes into the northern parts of the United States during the Civil War.

Use of biological agents became more sophisticated against both animals and humans during the 1900s. During the First World War the Germans were reported to have developed Anthrax, Glanders, Cholera, and a Wheat fungus for use as biological weapons. They allegedly spread plague in St Petersburg, infected mules with ganders in Mesopotamia, and attempted to do the same with the horses of the French Calvary.

For the first time **in 1925**, the **Geneva Protocol** was signed by **108 nations, including the 5 permanent members of the United Nations Security Council. This was the first multilateral agreement that extended prohibition of chemical agents to biological agents.** No method for verification of compliance was addressed.

During World War II, the Japanese operated a secret BW research facility in Manchuria and carried out human experiments on Chinese prisoners. They exposed more than 3000 victims to plague, anthrax, syphilis, and other agents. Victims were observed for development of disease, and autopsies were performed.

In 1957, the British government decided to end its offensive BW capabilities and destroy its weapon stockpiles.

During the Vietnam War, Vietcong guerrillas used fungi stakes dipped in faeces to increase the morbidity from wounding by these stakes.

The former Soviet Union (USSR) continued to develop biological weapons from 1950 to 1980. In the 1970s, the USSR and its allies were suspected of having used "yellow rain" (trichothecene mycotoxins) during campaigns in Laos, Cambodia, and Afghanistan. In 1979, an accidental release of anthrax from a weapons facility in Sverdlovsk, USSR, killed at least 66 people. The Russians denied this accident until 1992.

Recently, **terrorist organisations** have started use of biological agents. The most frequent bioterrorism episodes have involved **contamination of food and water**. In September and October of 1984, 751 persons were infected with Salmonella Typhimurium after an intentional contamination of restaurant salad bars in Oregon by followers of the *Bhagwan Shree Rajneesh*.

The threat that biological agents will be used on military forces and civilian populations, is now more likely than at any point in all of history, despite laws against it.

The disturbing fact is that biological agents are **easy to acquire, synthesize, and use**. It requires very small amount of agents to kill hundreds of thousands of people in a metropolitan or densely populated area, its concealment, transportation, and dissemination is relatively easy. In addition, Biological Warfare agents are difficult to detect or protect against; **they are invisible, odourless, and tasteless, and their dispersal can be performed silently**.

Dissemination of BW agents may occur by aerosol sprays, explosives (artillery, missiles, detonated bombs), or food or water contamination. Detection of biological agents involves either finding the agent in the environment or medical diagnosis of the agent's effect on human or animal victims. Early detection of a biological agent in the environment allows for early specific treatment and time during which prophylaxis would be effective. Unfortunately, currently no reliable detection systems exist for BW agents.

Methods are being developed and tested to detect a biological aerosol cloud using an airborne pulsed laser system to scan the lower altitudes upwind from a possible target area.

A detection system mounted on a vehicle also is being developed. This system will analyze air samples to provide a plot of particle sizes, detect and classify bacterial

cells, and measure DNA content, ATP content, and identify agents using immunoassays.

A biological warfare agent attack is likely to be hidden. Thus, detection of such an attack requires recognition of the clinical syndromes associated with various BW agents. Physicians must try to identify early victims and recognize patterns of disease.

All these require integrated and coordinated epidemiologic surveillance systems performing real-time monitoring with information shared at many levels of the health care system.

Source: Daniel J Dire, MD, FACEP, FAAP, FAAEM, Clinical Associate Professor, Department of Emergency Medicine, University of Texas-Houston

<http://www.emedicine.com/emerg/TOPIC853.HTM>, Ramayan, Mahabharat.

SLS - 4

Handout

Environmental Management

(source: NDMA Guidelines)

Disease outbreaks are mostly due to waterborne, airborne, vector-borne and zoonotic diseases. Environmental monitoring can help substantially in preventing these outbreaks. Integrated vector management also needs environmental engineering for elimination

of breeding places, supported with biological and chemical interventions for vector control. Biological events with mass casualty potential may result in a large number of dead bodies requiring adequate disposal procedures.

The following measures will help in the prevention of biological disasters:

a) Water supply:

A regular survey of all water resources, especially drinking water systems, will be carried out by periodic and repeated bacteriological culture for coliform microbes. In addition, proper maintenance of water supply and sewage pipeline will go a long way in the prevention of biological disasters and epidemics of waterborne origin such as cholera, hepatitis, and diarrhea & dysentery.

b) Personal hygiene:

Necessary awareness will be created in the community about the importance of personal hygiene, and measures to achieve this, including provision of washing, cleaning and bathing facilities, and avoiding overcrowding in sleeping quarters, etc. Other activities include making temporary latrines, developing solid waste collection and disposal facilities, and health education.

c) Vector control:

Vector control is an important activity which requires continuous and sustained

efforts. Cooperation of the community is very essential for a successful integrated vector management programme. The important components of vector control programmes are:

- i) Environmental engineering work and generic integrated vector control measures;
- ii) Elimination of breeding places by water management, draining of stagnant pools and not allowing water to collect by overturning receptacles, etc.;
- iii) Biological vector control measures such as use of Gambusia fish, is an important measure in vector control;
- iv) Outdoor fogging and control of vectors by regular spraying of insecticides; and
- v) Keeping a watch on the rodent population and detection of early warning signs, such as sudden fall in their numbers could preempt a plague epidemic. Protection against rodents can be achieved by improving environmental sanitation, storing food in closed containers and early and safe disposal of solid wastes. Killing of rodents associated with diseases such as plague and leptospirosis would require the use of rodenticides like zinc phosphides, digging and filling up of burrows, etc.

d) Burial/disposal of the dead:

Dead bodies resulting from biological disasters increase risk of infection if not disposed off properly. Burial of a large number of dead bodies may cause water contamination. with due consideration to the social, ethnic and religious issues involved, utmost care will be exercised in the disposal of dead bodies.

SLS – 5

Handout

Disposal of Animal Carcasses - A Prototype

(source: NDMA Guidelines)

a) If death was caused by a highly infectious disease

- i) Clean and disinfect the area after the carcass is removed;
- ii) Wear protective clothing when handling dead stock and thoroughly disinfect or dispose of clothing before handling live animals;
- iii) Properly dispose of contaminated bedding, milk, manure, or feed;
- iv) Check with the State Veterinarian about disposal options. Burial may not be legal. Special methods of incineration or burial may

be used in cases of highly infectious diseases; and

- v) Limit the access of the dead stock collector and his vehicle to areas well away from other animals, their feed and water supply, grazing areas, or walkways. The standard site requirements for disposal of dead animals are:

- ▲ 6 feet above bedrock, 4 feet above seasonal high ground water;
- ▲ 2 feet of soil on top, final cover;
- ▲ Greater than 100 feet from property lines; and
- ▲ Greater than 300 feet from water supplies.

b) Composting dead stock

If you compost your dead stock, follow the steps listed below:

i) Decide what method you will use.

Burial methods include static piles, turned windrows, turned bins, and contained systems. Information on the first three methods is available on several websites listed under ‘Resources on deadstock disposal.’

- Static piles with minimum dimensions of 4 feet long, by 4 feet wide, by 4 feet deep are by far the simplest to use;

- Turned windrows may be an option for farmers already composting manure in windrows;
- Turned bin systems are more common for handling swine and poultry mortalities; and
- The eco-pod is a contained system developed by Ag-Bag, which has been used to compost swine and poultry mortalities.

ii) Select an appropriate site.

- Well-drained with all-season accessibility;
- At least 3 feet above seasonal high ground water levels;
- At least 100 (preferably 200) feet from surface waterways, sinkholes, seasonal seeps, or ponds; and
- At least 150 feet from roads or property lines—think about which way the wind blows.

iii) Select and use effective carbon sources.

- Use materials such as wood chips, wood shavings, coarse sawdust, chopped straw or dry heavily bedded horse or heifer manure as bulking materials. Co-compost materials for the base and cover must allow air to enter the pile;

- If the bulking materials are not very absorbent, cover them with a 6-inch layer of sawdust to prevent fluids from leaching from the pile;
- Cover the carcass 2 feet deep with high-carbon materials such as old silage, dry bedding (other than paper), sawdust, or compost from an old pile;
- Plan on a 12' x 12' base for an adult dairy animal. The base should be at least 2 feet deep and should allow 2 feet on all sides around the carcass; and
- When composting smaller carcasses, place them in layers separated by 2 feet of material.

iv) Prepare the carcass.

- After placing the carcass on the base, lance the rumen of adult cattle. Explosive release of gasses may uncover the pile releasing odours and attracting scavengers.

v) Protect the site from scavengers.

- Adequate depth of materials on top of the carcass should minimize odours and the risk of scavengers disturbing the pile; and

- Scavengers may be deterred by the temperatures within the pile, but, if not, an inexpensive fence of upside down hog wire may be adequate to avoid problems.

vi) Monitor the process.

- Keep a log of temperature, carcass weight, and co-compost materials when each pile is started. Weather and starting materials will affect the process;
- Measure pile temperature with a compost thermometer 6 to 8 inches from the top of the pile and deep within to check for proper heating. Check daily for the first week or two. Pile temperature should reach 65oC for 3 consecutive days to eliminate common pathogens; and
- Record events or problems such as scavenging, odours, or liquid leaking from the pile. Wait. Most large carcasses will be fully degraded within 4-6 months. Smaller carcasses take less time. Turning the pile after 3 months can accelerate the process.

SLS - 6

Handout

Patient Isolation Precautions Standard Precautions

- a) Wash hands after patient contact;
- b) Wear gloves while touching blood, body fluids, secretions, excretions and contaminated items;
- c) Wear a mask and eye protection, or a face shield during procedures likely to generate splashes or sprays of blood, body fluids, secretions or excretions;
- d) Proper handling of patient-care equipment and linen in a manner that prevents the transfer of microorganisms to people or equipment; and
- e) Use proper precautions while handling a mouthpiece or other ventilation device as an alternative to mouth-to-mouth resuscitation. Standard precautions are employed in the care of all patients.

(source: NDMA Guidelines)

Patient Isolation Precautions (Contd...) Airborne Precautions

- a) Standard Precautions plus;
- b) Place the patient in a private room that has monitored negative air pressure, a minimum of six air changes/hour, and appropriate filtration of air before it is discharged from the room;
- c) Wear respiratory protection when entering the room; and
- d) Limit movement and transport of the patient. Place a mask on the patient, if the patient needs to be moved. Conventional Diseases requiring Airborne Precautions: Measles, Varicella, Pulmonary TB. Biothreat Diseases requiring Airborne Precautions: Smallpox.

(source: NDMA Guidelines)

Patient Isolation Precautions (Contd...)

Droplet Precautions

- a) Standard Precaution plus;
- b) Place the patient in a private room or cohort them with someone with the same infection. If not feasible, maintain at least three feet between patients;
- c) Wear a mask when working within three feet of the patient; and
- d) Limit movement and transport of the patient. Place a mask on the patient, if the patient needs to be moved.
- i) **Conventional Diseases requiring Droplet Precautions:**
Invasive Haemophilus influenzae and meningococcal disease, drug-resistant pneumococcal disease, diphtheria, pertussis, mycoplasma, Group A Beta Hemolytic Streptococcus, influenza, mumps, rubella, parvovirus.
- ii) **Biothreat Diseases Requiring Droplet Precautions:** Pneumonic Plague

(source: NDMA Guidelines)

Patient Isolation Precautions (Contd...)

Contact Precautions

- a) Standard Precautions plus;
- b) Place the patient in a private room or cohort them with someone with the same infection if possible;
- c) Wear gloves when entering the room. Change gloves after contact with infective material;
- d) Wear a gown when entering the room if contact with patient is anticipated or if the patient has diarrhea, a colostomy or wound drainage not covered by a dressing;
- e) Limit the movement or transport of the patient from the room;
- f) Ensure that patient-care items, bedside equipment, and frequently touched surfaces receive daily cleaning; and

(source: NDMA Guidelines)

Patient Isolation Precautions (Contd...)

Contact Precautions (Contd...)

- g) Dedicate use of non-critical patient-care equipment (such as stethoscopes) to a single patient, or cohort of patients with the same pathogen. If not feasible, adequate disinfection between patients is necessary.
 - i) **Conventional Diseases requiring Contact Precautions:**
Methicillin Resistant Staphylococcus aureus, Vancomycin Resistant Enterococcus, Clostridium difficile, Respiratory Syncytial Virus, parainfluenza, enteroviruses, enteric infections in the incontinent host, skin infections (Staphylococcal Scalded Skin Syndrome, Herpes Simplex Virus, impetigo, lice, scabies), hemorrhagic conjunctivitis; and
 - ii) **Bio-threat Diseases requiring Contact Precautions:**
VHFs.

(source: NDMA Guidelines)

17.2. Subject/Theme:

Agricultural Epidemics

PART-III

Introduction and Overview

Plants and animals are susceptible to large number of diseases and pests in nature, some of which assume epidemic proportions due to the appearance of more severe or virulent strains/races/ biotypes of the pests in a given area under certain favourable conditions, causing huge economic losses. Krishi Vigyan Kendrayas (KVK) are already established in all the 641 districts of India.

The information provided by the KVKs help farmers in controlling impact of pest & diseases and to reduce yield losses. KVKs are supported by State Agriculture Universities. In addition Agricultural Technology Management Agencies take up technology transfer activity.

Objectives

To sensitise farmers on various aspects of agricultural epidemics, ways to prevent and control them, role of farmers in meeting and mitigating this challenge.

Methods

Technical, lecture-cum-discussion, group-

work, interactive sessions, participatory method, simulation exercises, decision making games, quiz, practical and field visits.

Materials/Learning Aids

Audiovisuals, OHP/LCD, white board/black board, flip charts, sheets of paper, materials for first aid, etc.

Duration

Four sessions (Refer page no. 243).

Expected Learning Outcome

Cognitive/knowledge based:

- a) Knowledge of history of pest and disease attack in crops specific to the region, various aspects of diseases, its causes, consequences, whom to contact for technical advice and what measures to adopt at community level.

Competency/skill based:

Integrated Pest and Disease Management: Impart awareness & knowledge of pest and diseases and adopting Integrated Pest Management measures through safe use of pesticides and grain storage.

Sub-themes/discussion points

- a) What is a agricultural biological disaster?;
- b) Agricultural biological agents as causes of mass destruction;

- c) Indian experience of Agricultural Epidemics;
- d) Agricultural-epidemic connection and likely diseases during emergency situation;
- e) Agent-Host- environment, medium of infection;
- f) Causes, characteristics, effects, vulnerability;
- g) Legal framework, institutional and operational framework;
- h) Epidemic thresholds, role of surveillance, bio-safety laboratories;
- i) Mitigation measures;
- j) Preventive measures, risk communication and role of KVK;
- k) Preparedness measures;
- l) Control strategies, guidelines for safety and security;
- m) Rescue, recovery and Rehabilitation;
- n) Training and capacity building; and
- o) Do's and don'ts.

Supplementary Learning Support

- a) Handouts on Agricultural Epidemics, pest attacks;
- b) List of Do's and Don'ts;
- c) Slides; and
- d) Mitigation and prevention measures- Reference material.

Activity

In collaboration with the KVK, a brief outline of pest and diseases prevalent in the region along with do's and don'ts for major pest & diseases.

Further Study/References

- a) **Management of biological disasters**, NDMA, GOI, 2008
- b) Websites: **www.who.int**;
www.nicd.org;
www.ivri.nic.in;
www.ndma.gov.in;
www.mohfw.nic.in

Note for the Trainer/Facilitator

This is a highly technical session and needs to be handled by experts who could connect the agricultural epidemics to the disaster context.

PART-IV: Supplementary Learning Support Materials

SLS - 7

Handout

Pest Attacks

The 12th Finance Commission **has widened the scope of a natural calamity** requiring assistance from the Centre to include **pest attacks, landslides, avalanches and cloud bursts** besides **cyclones, droughts, earthquakes, fires, floods and hailstorms**.

Pest infestations are economically significant because of their potential to

reduce agricultural production. Controlling pest attacks is not a simple task since pests are biologically dynamic. Using pesticides to control pest attacks does not provide the expected outcomes. Understanding the nature of the relationship between pest infestations and pesticide use helps farmers and policy makers to take appropriate decisions.

Section 18

Additional Support Materials

Annexures

Annexure-I	471
-------------------	-----

Suggested Training and Orientation Schedule

for three different types of Trainees:

- (A)** Senior level CD, Home Guard and other senior functionaries working on disaster management issues, *p471*
- (B)** Mid-level Officials and Key Programme Personnel (KPP) including trainers, *p474*

(C) Key volunteers of CD, NCC, NYKS, NSS, Scout & Guides, Red Cross, etc., p482

Annexure – II **498**

Registration Form

Annexure – III **500**

Session Evaluation Format

Annexure – IV **502**

Field Visit Evaluation Format

Annexure – V **503**

Training Evaluation Format

Annexure – VI **505**

Post Training Evaluation Questionnaire

Annexure – VII **507**

Disaster Vocabulary and Terminologies

Annexure – VIII **518**

Technical Terms and Measures of Radioactive Substances

Contact Us **524**

Annexure – I (A)

Training and Orientation Schedules for Senior CD & other functionaries, Planners, Policy Personnel

Objective: To equip policy planner and senior level functionaries of the Civil Defence organisation, Home Guards, and other sister organisations with the latest developments in the field of disaster preparedness, policies, plans, programmes and implementation strategies.

Duration: One day

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
08.30 a.m. – 09.00 a.m.	Registration	Reception	Resource kit	Registration forms, pre-training questionnaires etc.
09.00 a.m. – 09.15 a.m.	Welcome and opening remarks	Broad objectives, Logistics, house keeping arrangements, etc	Course director, Facilitator welcomes the delegates.	
09.15 a.m. – 09.45 a.m.	Self introduction & program introduction, agenda building	Understanding each other, understanding the programme, expectation sharing, & building a consensus on the day's agenda	Presentation, Interaction	Programme schedule, sheets of paper, OHP, LCD
09.45 a.m. – 10.30 a.m.	New developments in Disaster Management Practices in India – paradigm shift, Policies and New Approaches, Mainstreaming Issues	Conventional Paradigm, Dominant Perspectives, Policies & Alternative Approaches, Disaster Management Structures and Institutions, Disaster Management Action Plans and Guiding Principles	Handouts, Slide show, Lecture-cum discussion, Co-facilitation	OHP, LCD, Audio-visual aids, Co-facilitations to be done by a senior and experienced participant or NCDC/NDM faculty

Annexure

Timings	Subject/ Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
10.30 a.m. – 11.30 a.m.	International Efforts and Commitments, Policies & Action Plans, Incident Response System (IRS), Humanitarian Charter etc. Disaster Imagery, Stereotypes and Ethics	International Decade for Natural Disaster Reduction (IDNDR), UN resolution on disasters. International Disaster Management Conference on Public Private Partnership, Geneva Mandate on Disaster Reduction. Disasters in South Asia- impact, issues and country profiles. Minimum standards of Disaster Response, various aspects of IRS	Handouts, Slide show	OHP, LCD, Audio-visual aids
11.30 a.m. – 11.45 a.m.		Health Break		
11.45 a.m. – 01.00 p.m.	New roles & challenges envisaged for CD, Implementation issues	CD Act and Structures, Review of new Roles and Responsibilities, High Power Committee (HPC) recommendations, Restructuring the CD services, new roles, training and capacity building	Handouts, slide show I. Handout- Existing CD Services & Services to be retained with Enhance Profile (pg. 26,31), 16	OHP, LCD, Audio-visual aids
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00p.m. – 02.45 p.m.	Engaging civil society, Involving Organisations of Youth volunteers (OYVs), Promoting spirit of Volunteerism, Challenges of Volunteer Management	Understanding work dynamics of civil society, OYVs, alliance building, synergy, Role of non-state agencies in disaster management, their knowledge & experience base and contribution in disaster mitigation, Public- Private Partnership framework, Public awareness and education, etc	Co-facilitation, Brainstorming	OHP, LCD, Audio-visual aids

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
02.45 p.m. – 03.30 p.m.	Addressing vulnerability and special groups, Elements of risk assessment and risk management, Hazard mitigation plan	Defining vulnerability, Social, cultural, economic & political aspects, Class, caste, ethnicity, gender, women, children and adolescents, aged, disables and poor, Basic information about a threat or event, its nature, intensity, frequency, consequences, Vulnerability of natural & human built environment, Identifying technologies and behaviour that reduce risks.	Discussion, Brainstorming, Handouts - Case study on Poverty & disaster (pg.20)	Audio-visual aids
03.30 p.m. - 03.45 p.m.		Health Break		
03.45 p.m. – 04.30 p.m.	Stakeholder co-ordination	Linkages and networking, Major disconnects in Disaster Response	Co-facilitation, Panel, Seminar, Discussion	OHP, LCD
04.30 p.m. – 05.15 p.m.	Defeating disasters- lessons learnt, Planning for future	Ideas for Action for a Safer Future Policy, Programme challenges, Capacity building of CD& other stakeholders, Lessons learnt from major disasters, New developments on early warning system, Prevention and risk reduction.	Brainstorming	Flip chart, marker, drawing sheets, sketch pens
05.15 p.m. – 05.30 p.m	Evaluation, Summing up	Course evaluation, Developing appropriate responses for new challenges.	Closing up, Concluding session	

Note for Facilitator: Please note that this is a flexible design. New issues of importance can be added from time to time. Only National level experts should be chosen as resource persons.

Annexure – I (B)

Senior and Middle level Officials and Key Programme Personnel including Trainers

Objective: To orient mid-level functionaries of the Civil Defence organisation, Home Guards, and other sister organisations about various aspects and types of disasters, their management, preparedness, approaches and strategies, capacity building ways and initiatives, knowledge and application of training methods to the disaster context, skills and competencies of working as **master trainers**.

Duration: Seven days

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY I				
09.00 a.m.- 09.30 a.m.	Registration		Resource kit, Reception of Delegates	Registration forms, Pre-course evaluation questionnaires
09.30 a.m.- 10.00 a.m.	Welcome & Opening remarks	Broad objectives, Logistics, House keeping arrangements, etc.	Course director, facilitator welcomes the delegates.	
10.00 a.m. – 11.00 a.m.	Warming up, Ice Breaking & self introduction by participants	Understanding each other	Pairing / Opinion collection/Interviewing	Chits, flashcards
11.00 a.m. – 11.15 a.m.	Health Break			
11.15 a.m. – 11.45 a.m.	Expectation sharing	Understanding the programme, Expectation sharing	Collecting feedback, Group discussion & Presentation	Flip charts, drawing sheets/marker

Timings	Subject/ Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.45 a.m. – 12.00 a.m.	Establishing ground rules for the training, Selection of the reporter for the day	Building a consensus	Mutual discussion moderated by facilitator	Flip chart, marker
12.00 p.m.– 01.00 p.m.	What is disaster- definition & debates, Concept clarification	Different perceptions, Disaster vocabulary & terms, Types, stages and phases of disasters	Quiz, Assessment of knowledge and perception, Discussion	Flip chart, marker, questions for quiz
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 P.M. – 03.30 P.M.	Disaster-causes, characteristics & consequences	Analysis of factors, Hazard, Vulnerabilities, capacities & risks	Incidence / case study sharing	Video, CD(s), Handouts
03.30 p.m. – 03.45 p. m.	Health Break			
03.45 P.M. – 04.45 p.m.	Disaster-Development linkages	What is development, Economic and Social impact of Disasters, Losses due to disaster and People affected by disasters.	Experience sharing / group work	OHP, PPP handouts
04.45 p.m.. – 05.00 p. m.	Gender issues & other special groups in Disaster	Special groups: women, children, adolescents, aged, otherwise able, etc.	Experience sharing / group work	Flip chart, sketch pen, Swallow tape
DAY-II				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-I, Selection of reporter for the day			

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	National & International initiatives on disaster management.	National disaster policy, IDNDR, HFA, Tampere Declaration on Disaster Communications, International Disaster Management Conference on Public Private Partnership, Geneva Mandate	Presentation & discussion	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Disaster communication	Information, communication and early warning systems	Experience sharing / Group work	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Disaster management	Disaster management cycle (response, rehabilitation, recovery, reconstruction, mitigation, preparedness), Risk assessment and management	Problem-centered and peer-critique technique	Flip chart, marker
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Community based disaster preparedness (CBDP)	What is disaster preparedness, Why community is important, Constraints and limitations of CBDP, Strengthening local coping mechanism, Team building, Safety procedures, Do's & don'ts, Lessons learnt, etc.	Role play, mock drills, group work	Flip chart, marker, handouts, charts, maps, board
DAY-III				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-II and selection of reporter for the day			

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	Floods and other water related disaster	Definition, types (flash floods, river floods, saline floods, urban floods, stagnation, flood due to mismanagement, etc) - Causes and effects	Experience sharing / group work	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 P.m.	Cyclone and other wind related disasters	Definition, types (Storm, tornado, hurricane, typhoon, Loo & heat & cold waves, etc)- Causes and effects	Experience sharing / group work, exercises	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Earthquake and other earth related disasters	Definition, types (Tsunami, Landslides, Avalanches, etc)- Causes and effects	Experience sharing / group work/exercises	Flip chart, marker, handouts, maps, board
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Drought and famine, other crop related disasters	Definition, types (Famine, epidemic, paste attack, etc)- Causes and effects	Experience sharing / group work/exercises	Flip chart, marker, handouts, charts, maps, board
DAY-IV				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-III and selection of reporter for the day			

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	Riots, violence and other conflict related disasters	Definition, types (Ethnic riots, political riots, war, etc) - Causes and effects, Do's and don'ts	Experience sharing / group work/simulation, games/case study	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Accidents & stampede	Definition, types (Road, rail, air, chemical and industrial, etc) Stampedes - causes and effects, Do's and don'ts	Experience sharing / group work/exercises	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Fire and other related disasters	Definition, types (Forest fire, village fire, fire in high rising buildings, fire in crowded public places, etc) - Causes and effects, Do's and don'ts	Experience sharing / group work	Flip chart, marker, handouts, maps, board
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Brainstorming on challenges and appropriate strategies	Identification of different challenges of both manmade and natural disasters, Develop appropriate strategies	Experience sharing / group work in 4 groups, two groups for identifying challenges (1 for manmade & 1 for natural disasters) and 2 groups for developing strategies to respond to the probable challenges.	Flip chart, marker

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY-V				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-IV and selection of reporter for the day			
09.30 a.m. – 01.00 a.m.	Field Visit to assess the disaster consequences and develop an action plan to respond to the situation.	Assessment of the situation, VCA, Identification of challenges, Collection of information on loss, Cross checking of the information, Need assessment and reporting, Source of resources and budgeting	Interview, data collection, cross check, PRA, group work	Flip chart, marker
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Field Visit contd.			
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Presentation of Field report	Findings of field visits	Group work	Flip Chart, marker
03.30 – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Disaster management structures and institutions, Disaster management Policy in India	Various structures and systems to implement DM policy in India	Lecture – cum-discussion	Flip Chart, marker

Annexure

Timings	Subject/Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY-VI				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-V and selection of reporter for the day			
09.30 a.m. – 11.00 a.m.	Disaster management plan	Linkage with development and gender issues, Contingency planning	Discussion, exercise, group work	Flip chart, marker, handouts, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session contd.	Volunteer management as part of planning	Discussion, exercise, group work	Flip chart, marker, handouts, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Civil Defence and disaster management	Role and responsibilities of civil defence till today, New emerging role to adopt disaster management	Brief overview, discussion	Flip chart, marker, handouts, board
03.30 p.m. – 04.00 p.m.	Health Break			
04.00 p.m. – 05.30 p.m.	Developing an action plan for disaster management	Action plan for pre, during, and post-disaster management	Group work in 4 groups,	Flip chart, marker
DAY-VII				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day VI and selection of reporter for the day			

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	Demonstration on training skills	Any disaster related topic opted by the participant	Role play (guided by facilitator)	Flip chart, marker, Board as required by the trainees
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session contd.	Evaluation and analysis of demonstration on training skill & methodologies	Discussion highlighting the learning points	
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Clarifications of queries, if any, Evaluation of training programme	---	Question/answer, Filling up of evaluation sheet	--
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Closing Session/ Valedictory	Certificate distribution	--	--

Note for Facilitator: This is a suggestive design - change or modify depending on the local needs.

Annexure – I (C)

Key Volunteers of CD, NCC, NYKS, NSS, Scout & Guides, Red Cross, etc.

Objective: We can term this as the foundation course for Disaster management. It aims to make the key volunteers familiar with various concepts, aspects and types of disasters; to enhance participants' efficiency/potential in management, preparedness, approach and strategies, capacity building, ways and initiatives, knowledge and application of training methods to the disaster context; to add to their skills and competencies enabling them to work effectively in disaster situations.

Duration: Fifteen days

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY I				
09.00 a.m. – 09.30 a.m.	Registration	Reception	Resource kit with reference materials	Registration forms, pre-course evaluation questionnaires
09.30 a.m. – 10.00 a.m.	Welcome & Opening Remarks		Course director, facilitator welcomes the delegates to the programme.	
10.00 a.m. – 11.00 a.m.	Ice Breaking & Self introduction of each participant	Knowing each other	Pairing, feedback collection, interviewing	Paper, chits, flash cards
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 12.00 noon.	Expectation sharing	Understanding primary expectations of the proposed programme	Obtaining views, group discussion & presentation	Flip charts, drawing sheets/marker

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
12.00 noon.- 12.15 p.m.	Establishing Ground rules for the training, Selection of the reporter for the day	To ensure discipline, promote participation, respect difference	Mutual interaction, discussion, short-listing ground rules	Flip chart, marker
12.15 p.m. – 1.00 p.m.	Knowledge & perception assessment on disasters	Identification of disasters based on their knowledge and understanding	Group work to identify disaster related events from newspaper & media, Conceive stories of their own	Newspapers from different dates, drawing sheets, sketch pens, flip chart, marker
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 P.M. – 03.30 P.M.	Presentation of pre-lunch Group work	Group learning about disasters	Group presentation Assessment of knowledge and perception, Discussion	Flip chart, marker
03.30 p.m. – 04.00 p.m.	Health Break			
04.00 p.m. – 05.30 p.m.	Disaster Scenario in India, International efforts	Brief history, chronological events	Information input	PPP Handouts
DAY II				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-I and selection of reporter for the day	To assess what was learnt and connect to new learning		

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	Civil Defence	What is it, its goal, aims, objectives, functions	Lecture, discussion	PPP Handouts
11.00 a.m. – 11.30 a.m.	Health Break			
11.30 a.m. – 01.00 p.m.	Civil Defence	Civil Defence Act, organisation, Structures, limitations	Lecture	Flip chart, marker, handouts, board
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 p.m. – 03.30 p.m.	Civil Defence	Roles and responsibilities, restructuring CD organisations, High Power Committee recommendations, New roles	Lecture, Discussion	Flip chart, marker, handouts, board
3.30 p.m. – 04.00 p.m.	Health Break			
04.00 p.m. – 05.30 p.m.	Civil Defence & other sister organisations, NGOs, civil society coordination	Promoting spirit of volunteerism, Linking with other sister organisation, Volunteer management strategies, Leadership & motivation, Role of youth organisations, Networking and alliance building		Flip chart, marker, handouts, board

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
07.00 p.m. – 09.00 p.m.	Audio-visual / documentary on group leadership, disaster definition, etc	--	Video show	VCD, CD, etc
DAY III				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-II and selection of reporter for the day			
09.30 – 11.00 a.m.	All about Disaster –	Characteristics of disasters, meaning & Definition, Disaster vocabulary, Disasters types, characteristics, causes and consequences	Quiz, discussion, interaction	Flip chart, marker, handouts, board
11.00 – 11.30 a.m.		Health Break		
11.30 – 01.00 p.m.	Disaster and development	Linking both	Brainstorming, lecture	PPP Handouts
01.00 – 02.00 p.m.		Lunch Break		
02.00 – 03.30 p.m.	Special Issues in disaster management	Aged, women, children, differently abled persons	Group opinion collection, discussion	Whiteboard marker

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
3.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Impact of disaster Management (a given situation) on different vulnerable groups	Impact on women, aged, children, differently abled persons	Small group activity	Flip chart, marker
07.00 p.m. – 09.00 p.m.	Audio-visual show / documentary on impact of disaster	--	Video show	VCD, CD, etc
DAY IV				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-III and selection of reporter for the day			
09.30 a.m. - 11.00 a.m.	Disaster management plan	Disaster management cycle, Linking to development	Experience sharing / group work	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session Contd..	Contingency planning, Volunteer management, Gender issues	Experience sharing / group work	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Disaster Management Action	Early warning, assessment, search and rescue, first aid, shelter and relief management, team co-ordination, team work, reporting, etc	Experience sharing / group work/exercises	Flip chart, marker, handouts, maps, board

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Disaster assessment	Risk, hazard, vulnerability, capacity, risk management, relief issues	Experience sharing / group work	Flip chart, marker, handouts, maps, board
07.00 p.m. – 09.00 p.m.	Audio-visual show / documentary on community participation in post-disaster situation	Group learning	Video show	VCD, CD, etc
DAY V				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-IV			
09.30 a.m. – 11.00 a.m.	Practical sessions on Search & Rescue	Use of ropes, Alternate arrangement of tools, rope and stick	Practical	Ropes, sticks of different sizes
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Contd..	Contd..		
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Contd..	Search and rescue in water, forest, thick fire, high rise buildings, deep wells, mines, trees, vulnerable and risky places	Practical	
03.30 p.m. – 04.00 p.m.		Health Break		Practical

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
04.00 p.m. – 05.30 p.m.	Demonstration by the participants	Contd..		
07.00 p.m. – 09.00 p.m.	Cinema / documentary on Search and rescue methods	--	Video show	VCD, CD, etc
DAY VI				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-V			
09.30 a.m. – 11.00 a.m.	Basics of Disaster First Aid	What is first aid, principles of first aid, qualities of first aider	Lecture-cum-discussion	PPP Handouts
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Contd..	Understanding the human body structure	Demonstration	Maps, pictures, skeleton
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Contd..	Tackling wounds, bleeding, fractures, poisoning, drowning, etc	Practical	Bandage, gauge, cotton, etc
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Contd.	Cardio-pulmonary resuscitation (CPR), Artificial respiration	Practical	VCD, CD, etc
07.00 p.m. – 09.00 p.m.	Cinema / documentary on use of First-aid tools	--	Video show	VCD, CD, etc

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY VII				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-VI and selection of reporter for the day			
09.30 a.m. – 11.00 a.m.	Floods – Nature & characteristics	Definition, Causes and impact	Experience sharing / group work	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Types of Flood	Flash floods, river floods, saline floods, urban floods, stagnation flood, mitigation measures; Do's & don'ts		PPP
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Rescue mechanism during flood	Effective tools, skilled volunteer, Plan & management of flood	Group activity	Flip chart, marker
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Session contd..	Do's and don'ts	Role play	--
07.00 p.m. – 09.00 p.m.	Cinema / documentary on flood & its impact	--	Video show	VCD, CD, etc

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
DAY VIII				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-VII and selection of reporter for the day			
09.30 a.m. – 11.00 a.m.	Cyclone and other wind related disasters	Definition, types (Storm, tornado, hurricane, typhoon, Loo &, lightning, etc)- causes and effects	Experience sharing / group work	Flip chart, marker, hand-outs, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session contd.		Experience sharing / group work	Flip chart, marker, hand-outs, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Rescue mechanism for Cyclone	Plan & management, of cyclone, Lessons learnt; Do's and Don'ts	Experience sharing / group work	Flip chart, marker, hand-outs, maps, board
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Session contd.	Identification of different challenges of both man-made and natural disasters and develop	Experience sharing / Group work in 4 groups, two groups for identifying challenges	Flip chart, marker

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
07.00 p.m. – 09.00 p.m.	Cinema / documentary on Cyclone & its impact	appropriate strategies, Do's and don'ts, Guidelines	(1 for manmade & 1 for natural disasters) and 2 groups for developing strategies to respond the probable challenges. Video show	VCD, CD, etc
DAY IX				
09.00 a.m. – 11.00 a.m.	Field Visit/Study			
11.00 a.m. – 11.30 a.m.			Health Break	
11.30 a.m. – 01.00 p.m.	Field Visit /Study Continued			
01.00 p.m. – 02.00 p.m.			Lunch Break	
02.00 p.m. – 3.30 p.m.	Field visit /Study continued			
03.30 p.m. – 04.00 p.m.	Health Break			
04.00 p.m. – 05.30 p.m.	Field visit /Study continued			
07.00 p.m. – 09.00 p.m.	Preparation of field reports			Drawing sheet, sketch pens
DAY X				
09.00 a.m. – 09.30 a.m.	Presentation Of Report of day IX			Drawing sheet, sketch pens

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
09.30 a.m. – 11.00 a.m.	Presentation of field reports			
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Contd.			
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 p.m.– 3.30 p.m.	New Strategies/Initiatives/ap-proaches on disaster management	Disaster response	Lecture/discussion/ group work	PPP, flip chart, marker
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Coordination	Networking and com-mand system	lecture	PPP
07.00 p.m. – 09.00 p.m.	Cinema / documentary on Civil defence intervention	--	Video show	VCD, CD, etc
DAY XI				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-X and selec-tion of reporter for the next day			
09.30 a.m. – 11.00 a.m.	Earthquake and other earth re-lated disasters	Definition types (Tsu-nami, Landslides, Avalanches etc.)-causes and effects	Experience sharing/ group work/exercises	Flip chart, marker/PPP

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session contd.	Do's and don'ts, guidelines		handouts, slides
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Rescue mechanism for earthquake/Tsunami/avalanches/landslides	Effective tools, Skilled volunteer, Plan and management of flood	Group work and exercises	Flip chart, marker
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Session contd.	Disaster management circle (response, rehabilitation, recovery, reconstruction, mitigation, preparedness)	Problem-centered and peer-critique technique	Flip chart, marker
07.00 p.m. – 09.00 p.m.	Cinema / documentary on earthquake, tsunami, landslide & their impact	--	Video show	VCD, CD, etc
DAY XII				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-VII and selection of reporter for the day			
09.30 a.m. – 11.00 a.m.	Drought & famine – nature, characteristics and responses	Definition, types (famine, epidemic, paste attack, etc)- causes and effects	Discussion, exercise, group work	Flip chart, marker, handouts, maps, board

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Session contd.	Volunteer management as part of planning	Discussion, exercise, group work	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Management of drought and famine	Planning & management for drought and famine	Brief overview, discussion	Flip chart, marker, handouts, maps, board
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Session Contd.	Epidemic management	Group work in 4 groups,	Flip chart, marker
07.00 p.m. – 09.00 p.m.	Cinema / documentary on drought, famine	--	Video show	VCD, CD, etc
DAY XIII				
09.00 a.m. – 09.30 a.m.	Recapitulation of Day-VIII and selection of reporter for the day	High-rise		
09.30 a.m. – 11.00 a.m.	Fire Hazards – Characteristics & nature	Definition, causes and effects	Experience sharing / group work	Flip chart, marker, handouts, maps, board
11.00 a.m. – 11.30 a.m.		Health Break		

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.30 a.m. – 01.00 p.m.	Types of fire and their impact	Forest fire, village fire, fire in high-rise buildings, fire in crowded public places, etc	Experience sharing / group work / exercises	Flip chart, marker, handouts, maps, board
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 p.m. – 03.30 p.m.	Heat & Cold wave- Types, causes, impact	History, how they occur, steps for safety emergency assistance	Experience sharing / group work	Flip chart, marker, handouts, maps, board
03.30 p.m. – 04.00 p.m.	Health Break			
04.00 p.m. – 05.30 p.m.	Rescue mechanism for house fire, forest fire, heat & cold wave	Details of rescue, public awareness, Do's & don'ts	Experience sharing / group work	Flip chart, marker, handouts, maps, board
07.00 p.m. – 09.00 p.m.	Cinema / documentary on fire disaster	--	Video show	VCD , CD, etc
DAY XIV				
09.00 a.m. – 09.30 a.m.	Presentation of day XIII report			
09.30 a.m. – 11.00 a.m.	Accidents- Nature & characteristics, types of Accidents & impact	Definition, Causes and effects, types (road, rail, air, chemical and industrial, Stamped, etc)	Group work in 4 groups	Flip chart, marker

Annexure

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.00 a.m. – 11.30 a.m.		Health Break		
11.30 a.m. – 01.00 p.m.	Special care	Aspects of Psycho-social care & treatment		Flip chart, marker
01.00 p.m. – 02.00 p.m.		Lunch Break		
02.00 p.m. – 3.30 p.m.	Violence & conflict	Nature, types, cause and consequences, response	Group work in 4 groups	Flip chart, marker
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Rescue, response mechanism for accidents including war & conflict, stampede.	Plan & management for Accidents, war, conflict, stampede, Do's & don'ts	Group work in 4 groups	Flip chart, marker
07.00 p.m. – 09.00 p.m.	Cinema / documentary on accidents and their impact	--	Video show	VCD, CD, etc
DAY XV				
09.00 a.m. – 09.30 a.m.	Presentation of day XIV report			
09.30 a.m. – 11.00 a.m.	Disaster management principles	Policies, codes, standards and conducts	Lectures	PPP handouts
11.00 a.m. – 11.30 a.m.		Health Break		

Timings	Subject / Topic	Sub theme / Key Learning Points	Methods / Materials	Tools
11.30 a.m. – 01.00 p.m.	Contd.			
01.00 p.m. – 02.00 p.m.	Lunch Break			
02.00 p.m. – 3.30 p.m.	Evaluation	Course evaluation, developing appropriate responses for new challenges.	Filling up	Evaluation formats
03.30 p.m. – 04.00 p.m.		Health Break		
04.00 p.m. – 05.30 p.m.	Summing up	Lessons learnt	Closing up	

Note for Facilitator: *Modify this design based as per the changing needs of the trainees.*

Annexure – II

Registration Form*

Title of the training Course:

Duration:

Dates:

Venue :

Name of the Course Director/ coordinator -:

1. Name of the Trainee
2. Contact Address, Phone Number, email id.
3. Date of Birth
4. Academic/Professional Qualifications
5. Name of the Organisation associated with (if Any)
7. Designation / work title
8. Work Experience
9. How did you come to know about this training?
10. Have you opted for this training course voluntarily, if yes, why?
11. Do you feel you already have some knowledge about the course you have come to attend?
12. What is your expectation from this Course, more so, on following aspects?

Knowledge / Information

Skills / competencies

*Attitudinal and behavioral
changes*

Strengthening capabilities

Any other

- | | | | |
|-----|---|-----|----|
| 13. | Are you aware of the basic objectives and training methodology for this course? | Yes | No |
| 14 | How much you feel attending this course will improve your performance in future and strengthen your capabilities? | | |

Annexure – III

Session Evaluation Format *

- | | | | |
|-----|--|--------------------|----|
| 1. | Subject / theme of the Session | | |
| 2. | Name of the Resource person / facilitator | | |
| 3. | Was there any material/handout provided to you about the topic covered in this session at the start of the course? | Yes | No |
| 4. | If yes, did you read it before hand and noted down certain points for further clarification? | | |
| 5. | What is your rating of the following? : | E V G G A P | |
| | Contents of the Presentation | | |
| | Methodology used | | |
| | Delivery of the subject | | |
| | Session and time management by the Facilitator / resource person | | |
| | Interaction with the participants | | |
| | Skill imparted | | |
| 6. | Was there any discussion on the topic covered in the session | Yes | No |
| 7. | If yes, did you participate? | Yes | No |
| 8. | If no, what made you not to participate | | |
| 9. | Are you satisfied with the question – answer/discussion? | Yes | No |
| 10. | Would you like the same person to be invited again for the said subject? | Yes | No |
| 11. | If no, what kind of resource person, you feel, should conduct this session? | | |
| 12. | Which key objective of the Course has been fulfilled through this session? | | |
| 13. | What were your expectations from this session? | | |

14.	Whether your expectations have been met with?	Yes	No
15.	If no, why?		
16.	Has this session :		
	Increased your knowledge level ?	Yes	No
	Inculcated some new skills in you?	Yes	No
	Reinforced already existing skills?	Yes	No
	Motivated you to apply what you have learnt?	Yes	No

(E – Excellent; VG – Very Good; G – Good; A – Average; P – Poor)

Annexure – IV

Field Visit Evaluation Format *

1. Name of the place visited
2. Purpose of the visit
3. Did you have enough information before hand about the purpose of the visit?
4. What were your expectations from the visit?
5. Whether any exercise/mock-drill was conducted during the visit?
6. Were you made familiar with the methodology for conducting the exercise?
7. How actively did you participate in the field exercise? 100% 75% 50% 25% Not at all
8. What have you gained from the field visit and exercise?
9. Do you recommend such exercise/s to be conducted during this training course even in the future?
10. What is your overall rating of the field visit/ exercise / mock-drills? E VG G A P

(E – Excellent; VG – Very Good; G – Good; A – Average; P – Poor)

Annexure – V

Training Evaluation Format*

- Title of the Training program :
- Duration :
- Dates :
- Venue :
- Name of the :
- Course Director/Coordinator
- Name of the :
- Training Institution/Agency
1. Name of the participant / trainee
 2. When did you get Background Training Material/resource kit?
 - At the place of work
 - Immediately after reaching the venue of the course
 - Same day
 3. If material was not sent to you earlier, do you feel it should have been and if so, how much in advance?
 4. If the material had been sent to you earlier, had you read it before hand?
 5. What were your expectations from this course?
 6. Do you feel this course fulfils your job needs?
 7. If yes, how and if not, what could have been laid more emphasis upon?
 8. Are you satisfied with the key objectives of this training?
 9. If no, what more could have been added in the list of objectives?
 10. Do you feel the sessions/exercise/s scheduled in the course matched with the objectives?
 11. If no, what are your suggestions?
 12. Are you satisfied with learning outcome?

13. Has the training benefited you on following aspects?
- Knowledge / Information
 - Practical Aspects
 - Skills and competencies
 - Attitude and Behavioural Changes
14. Do you feel you would be able to use the training outcomes in your job situation?
15. If yes, how and if no, what could have been stressed upon?
16. Do you feel motivated after attending the course to train/orient/reorient your other colleagues?
17. Are you satisfied with the training facility and arrangements during the course. Yes No
18. If no, what are your suggestions?
19. What, in your opinion was the attitude of the following?
- Course Director/Coordinator E VG G A P
 - Resource person/experts
 - Support staff
 - Persons in charge of accommodation and food
20. What is your rating of the interaction with fellow participants? E VG G A P
21. Please be specific regarding felt improvements in :
- Training Material/Kit
 - Listing of subject / themes
 - Conduct of sessions
 - Theory – Practice – Skills / exercises
22. What is your overall rating of the course? E VG G A P

Annexure – VI

Post Training Evaluation Questionnaire *

Multiple Choice Item Mark (✓) to the right answer

- 1. Which one amongst the following is not a man-made disaster?**
 - ★ War
 - ★ Conflict.
 - ★ Industrial accidents
 - ★ Tornado
- 2. Which one of the following is not associated with climate disasters**
 - ★ Earthquake
 - ★ Cyclone
 - ★ Floods
 - ★ Drought
 - ★ Famine
- 3. The amount of energy released at the epicenter in case of earthquake is indicated by**
 - ★ Richter Scale
 - ★ Hecto Pascal
 - ★ Modified Mercalli Scale
 - ★ None of the above
- 4. Natural Disaster Management Division in India is located in the**
 - ★ Ministry of Home Affairs
 - ★ Ministry Of Labour and Employment
 - ★ Ministry of Agriculture and Cooperation
 - ★ Ministry of Human Resource Development
- 5. Who amongst the following officers is the focal point at the district field level planning, directing, supervising and monitoring relief measures for disasters?**
 - ★ Collector or Deputy Commissioner
 - ★ Secretary of the State
 - ★ Revenue Divisional Officer

- ★ DDO/Mamaltdar/ village panchayat

6. Mitigation means:

- ★ Estimates of all the loss/damage,
- ★ deaths/injuries, evacuation, rehabilitation,
- ★ etc. after the occurrence of an accident/disaster.
- ★ Long term measures taken before a disaster
- ★ to lessen its effect on the community
- ★ Analysis of reasons of what went wrong
- ★ before the onset of disaster, once the normalcy
- ★ is restored
- ★ None of the above

7. Preparedness Measures means

- ★ Estimates of all the loss/damage
- ★ deaths/injuries
- ★ evacuation
- ★ Rehabilitation etc after the occurrence of an accident/disaster

** Adapted from the "Disaster Management Hand Book "Document developed by IGNOU,*

Annexure – VII

Disaster Vocabulary and Terminologies

ACCIDENT: An undesirable or unfortunate event that occurs unintentionally arising from carelessness, unawareness, ignorance, system failure or a combination of these causes which usually leads to harm, injury, loss of life, livelihood or property or damage to the environment.

ACID RAIN: This should be called acid precipitation because it includes rain, snow, sleet, fog and any other form of precipitation. It is produced as industrial by-products in emissions of sulphur and nitrogen oxides from burning coal and petroleum products. Found throughout the world, its heaviest concentration is in urban areas.

AFFORESTATION: Conversion of bare or cultivated land into forest.

AGRICULTURAL WASTE: Poultry and livestock manure or residual materials in liquid or Solid form generated in the production and marketing of poultry, livestock, fur-bearing animals and their products, rice straw, rice husks and other plant wastes.

AIR POLLUTION: The introduction of substances into the air which makes it impure.

ALPHA RADIATION: Alpha rays consists of nuclei of the element helium and carries a positive charge. They do not penetrate strongly, but do great damage in a small area.

AQUIFER: A geological formation which is usually composed of rock, gravel, sand or other porous material and which yields water to wells or springs. Can be polluted by introduction of pollutants through poorly capped wells, injection waste disposal and other entries below ground.

BACKGROUND RADIATION: Radiation that occurs naturally in the environment from cosmic rays and radon or from atomic tests and other nuclear activities carried out by man.

BETA RADIATION: Beta particles are electrons emitted from the nucleus of an atom and carry a single negative charge. They penetrate more than alpha rays, can cause skin burns and, when ingested, cancer.

BIOACCUMULATIVE: A characteristic of chemicals in species when the rate of intake into a living organism is greater than the rate of excretion, or metabolism. This results in an increase in tissue concentration relative to the exposure concentration.

BIOLOGICAL HAZARDOUS WASTE: Any substance of human or animal origin, excluding food wastes, which is disposed of and which could harbour or transmit pathogenic organisms. Such waste includes tissues, blood elements, excreta, secretions, bandages and related substances.

BIOMASS: Any organic material that can be turned into fuel-wood; includes dry plants and organic wastes.

CARCINOGEN: Substances that causes cancers. Some substances may be indirect carcinogens, which damage some body cells that then become sensitive to other substances that cause cancer.

CARRYING CAPACITY: A concept which holds that the maximum amount of life supportable by a natural biological system is determined by the maximum yield it can sustain without suffering damage. The maximum sustainable yield is determined by the system's size and regenerative powers.

CHLOROFLUOROCARBONS (CFCs): Manufactured gases used in refrigerators, air conditioners, solvents, food frezants and sterilants, and for making plastic foam used in fast-food containers, cups, insulation, packing material and other products. When released into the earth's atmosphere they react chemically and damage the ozone layer, thereby exposing people to dangerous levels of ultraviolet radiation from the sun.

CYCLONE/HURRICANE/TYPHOON: The terms hurricane and typhoon are regional names for a strong 'tropical cyclone'. All originate in tropical or sub-tropical waters and must spawn winds in excess of miles per hour.

Hurricane- north Atlantic Ocean. Typhoon – Pacific Ocean east of the international date line. Severe tropical cyclone – southwest Indian Ocean.

DEFORESTATION: The loss of forests due to collection of fuel wood, commercial logging, shifting cultivation, grazing, road construction, ranching mining and fire. Leads to soil erosion and flooding and endangers wildlife through habitat destruction.

DESERTIFICATION: A process whereby the productivity of the land is reduced through

deforestation, water logging and salinization, chemical degradation by nutrient leaching, and range-land mismanagement such as overgrazing, soil erosion and aridity and semi aridity.

DISASTER: An unforeseen and often sudden event that causes great damage, destruction and human suffering. Though often triggered by a natural hazard, Disasters can have human origins. An event is classified as a disaster when it results in a serious disruption of the functioning of society, causing widespread human, material, or environmental losses which exceed the ability of the affected society, causing to cope using only its own resources.

DISASTER MANAGEMENT: A collective term encompassing all aspects of planning for and responding to disasters, including both pre-and post-disaster activities. It may involve the management of both the risks and consequences of disasters.

DISPLACED PERSON: A term usually applied to person fleeing their homes because of an armed conflict, civil disturbance or natural disaster. It refers to people as long as they remain within the borders of their own country. Once they cross into another country they are defined, in most cases, as refugees.

DISSOLVED OXYGEN: Oxygen found in water and is required by organisms for survival; as the amount of sewage increases in water, bacteria multiply to feed on the sewage and consume more oxygen, thereby decreasing the amount in the water available for use by other animals living there.

DROUGHT: A normal, recurring feature of climate that originates from a lack of precipitation over an extended period of time, usually a season or more. Drought can occur in virtually all climates.

EARTHQUAKE: A shaking of the earth caused by a sudden movement of rock beneath its surface. An earthquake occurs on a fault, which is a thin layer of crushed rock between two blocks of rock. A fault can range in length from a few centimetres to thousands of miles.

ECOSYSTEM: The interacting system of the biological community and its non-living environment.

EMERGENCY: An extraordinary situation where there are serious and immediate threats

to human life as the result of a disaster, the imminent threat of disaster, the cumulative process of neglect , civil conflict, environmental degradation and social-economic conditions.

EMERGENCY PREPAREDNESS: To develop the capability during normal conditions to take action for utilising all available/mobilised resources that will effectively mitigate the consequences of an emergency and ensure safety and health of the people, quality of life, property and the environment.

EMERGENCY RESPONSE: Actions under conditions of stress created by an emergency, to mitigate the consequences of the emergency on the safety and health of the people, their quality of life, property and the environment. It may also provide a basis for the resumption of normal social and economic activities.

ENVIRONMENTAL REPORTING: Communicating information about interrelationships between man and the natural and man-made environment, events or conditions.

EROSION: The loss of surface soil through the action of precipitation and wind. Leads to sedimentation and situation of water-ways which destroy aquatic and marine habitats, make water undrinkable and clog water dependant industrial machinery and other intake equipment.

EXERCISE: The term exercise designates any type of drill, trial, tabletop, partial, full-scale and field exercise.

FAMINE: A lengthy period of time during which people experience a severe lack of food. War, poverty, drought, floods, volcanic eruptions, earthquakes and other disasters can cause famines. According to the United Nations, an estimated 20 percent of the populations of developing countries- more than 800 million people- are food deficient.

FIELD EXERCISE: An exercise involving the deployment of emergency response teams and personnel on or around the site.

FIRST RESPONDER: The member of an emergency service to arrive first at the scene of an emergency to provide rescue and relief operations.

FLOOD: Floods, especially flash floods, kill more people each year than hurricanes, Tornadoes wind storms or lightning. Flood water can be deceptively strong. Fresh water moving at 4 mph (a brisk walking pace) exerts a force of about 66 pounds on each square

foot of anything it encounters.

FOOD SECURITY: Access by all people at all times to enough food for an active, healthy life. Its essential elements are availability of food and ability to acquire it. The U N Food and Agriculture Organisation’s definition of food security includes the following requirements: adequate supply, stable supply, and access to the supply (including adequate consumption, adequate income in relation to food prices and access to employment).

FLY ASH: The airborne combustion residue from burning coal or other fuels, consists of mainly of various oxides and silicates. Major sources are pulverized coal-burning boilers

GAMMA RAYS: Electromagnetic rays similar to X-rays, emitted from an unstable atom’s nucleus, which travel in straight paths at the speed of light, penetrate matter readily, but do not make the material radioactive. They penetrate a greater area than alpha or beta rays, but do less damage because they are a weaker form of radiation.

GAMMA RAY IRRADIATION: Experimental hazardous waste chemical treatment method, which disinfects waste by utilizing gamma radiation to destroy disease causing organisms.

GENEVA CONVENTIONS: A series of international agreements that provide the legal basis for the International Red Cross and Red Crescent Movement. They reaffirm the value of human life and dignity during times of war.

GREENHOUSE EFFECT: The theory that continued burning of fossil fuels will increase concentrations of carbon dioxide in the atmosphere, thereby trapping additional heat and moisture. In time, this will raise temperature levels.

GROUND WATER: The portion of the subsurface water, which is in the zone of saturation where nearly all openings between soil particles are filled with water. The top of the zone of saturation in the ground is called the water table.

HABITAT: The sum of total environmental conditions of a specific place that is occupied by an organism, a population or community.

HAZARD: A hazard is a natural or human-made phenomenon which may cause physical damage, economic losses, or threaten human life and well-being if it occurs in an area of human settlement, agricultural or industrial activity.

HAZARD ASSESSMENT: The process of estimating, for defined areas, the probabilities of the occurrence of potentially damaging phenomena of given magnitude within a specified period of time. Hazard assessment involves analysis of formal and informal historical records and skilled interpretation of existing topographical, geological, geomorphological, hydrological and land-use maps.

HAZARD MAPPING: The process of establishing geographically, where and to what extent particular phenomena are likely to pose a threat to people, property, infrastructure, and economic activities.

HAZARDOUS WASTE: Any waste which is ignitable, corrosive, reactive or toxic and which may pose a substantial or potential hazard to human health and safety or to the environment when improperly managed (reactive refers to the ability to enter into a violent chemical reaction which may involve an explosion or fumes).

HAZMATS: 'Techno jargon' for hazardous materials which, if released or misused, could pose a threat to people and the environment. HazMats can be explosives, flammable and combustible substances, poisons and radioactive materials.

HUMAN-MADE DISASTER (MANMADE DISASTER): A disaster or emergency situation whose principle, direct causes are identifiable human actions, deliberate or otherwise. Apart from 'technological disasters' this mainly involves situations in which civilian populations suffer casualties, loss of property, basic services and means of livelihood as a result of war, civil strife, other conflict or policy implementation.

HYDROCARBONS: Any of a large class of organic compounds containing only carbon and hydrogen. The molecular structure of hydrocarbon compounds varies from the simplest, methane, to heavier and more complex molecules such as octane, a constituent of crude oil and natural gas, which are often referred to as hydrocarbons or hydrocarbon fuels.

INCIDENT: An occurrence or event of minor importance.

INTERVENTION: Any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident.

LANDMINE: A landmine is an explosive device designed to be placed on or in the ground to explode when triggered by an operator or the proximity of a vehicle, person, or animal. The name originates from the practice of mining, where tunnels were dug under enemy fortifications or forces.

MITIGATION: The process of preventing disasters or reducing related hazards. Methods of limiting damage can be as simple as placing a fuse box higher on a wall in a flood-prone area, or as costly as strengthening a building's structure to withstand an earthquake.

MONSOON: A monsoon is a seasonal prevailing wind which lasts for several months. The term was first used in English in India, Bangladesh, Pakistan, and neighboring countries to refer to the big seasonal winds blowing from the Indian Ocean and Arabian Sea in the southwest bringing heavy rainfall to the region.[1] In hydrology, monsoon rainfall is considered to be that which occurs in any region that receives the majority of its rain during a particular season.

NATURAL HAZARDS: A natural hazard or geophysical hazards is a threat of an event that will have a negative effect on people or the environment. Many natural hazards are related, e.g. earthquakes can result in tsunamis, drought can lead directly to famine and disease.

NUCLEAR OR RADIOLOGICAL DISASTER: When the impact of a nuclear or radiological emergency, caused by a nuclear attack (as happened at Hiroshima and Nagasaki in Japan) or large-scale release of radioactivity from nuclear/radiological facilities (like that at Chernobyl in Ukraine) is very high, it assumes the dimension of a nuclear disaster leading to mass casualties, disruption of normal services, and destruction of large areas. Unlike nuclear emergency, the impact of nuclear disaster is beyond the coping capability of local authorities and such a scenario calls for handling at the National level, with assistance from international agencies, if required.

NUCLEAR OR RADIOLOGICAL EMERGENCY: An emergency in which there is, or is perceived to be, a hazard due to: (a) the radiation energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction; or (b) radiation exposure. Such emergencies are usually well within the coping capability of the plant/facility authority along with the neighbouring administrative agencies, if required.

OZONE HOLE: A growing hole in the stratospheric ozone layer appearing each year over the Antarctic for a few weeks in October. Ozone depletion describes two distinct,

but related observations: a slow, steady decline of about 4 percent per decade in the total amount of ozone in Earth's stratosphere since the late 1970s; and a much larger, but seasonal, decrease in stratospheric ozone over Earth's polar regions during the same period. The latter phenomenon is commonly referred to as the ozone hole.

OZONE LAYER: The ozone layer is a layer in Earth's atmosphere which contains relatively high concentrations of ozone (O₃). This layer absorbs 93-99% of the sun's high frequency ultraviolet light, which is potentially damaging to life on earth.

PHYTO-TOXIN: Literally meaning "plant poison," a phytotoxin can refer to any toxin produced by a plant.

POINT-SOURCE POLLUTION: A point source of pollution is a single identifiable localized source of air, water, thermal, noise or light pollution. A point source has negligible extent, distinguishing it from other pollution source geometries. The sources are called point sources because in mathematical modelling, they can be approximated as a mathematical point to simplify analysis.

POLLUTION: It is the introduction of contaminants into an environment, of whatever predetermined or agreed upon proportions or frame of reference; these contaminants cause instability, disorder, harm or discomfort to the physical systems or living organisms therein. Pollution can take the form of chemical substances or energy, such as noise, heat or light energy.

POLYCHLORINATED BIPHENYLS (PCBs): PCBs are a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl which is a molecule composed of two benzene rings each containing six carbon atoms. The chemical formula for all PCBs is C₁₂H_{10-x}Cl_x.

PREPAREDNESS: Refers to the State of being prepared for specific or unpredictable events or situations. Preparedness is an important quality in achieving goals and in avoiding and mitigating negative outcomes. It is a major phase of emergency management, and is particularly valued in areas of competition such as sport and military science.

PROTECTIVE ACTION: An intervention intended to avoid or reduce doses to members of the public in emergencies or situations of chronic exposure.

RADIATION: As used in physics, Radiation is energy in the form of waves or moving

subatomic particles emitted by an atom or other body as it changes from a higher energy State to a lower energy State. Radiation can be classified as ionizing or non-ionizing radiation, depending on its effect on atomic matter. The most common use of the word “radiation” refers to ionizing radiation. Ionizing radiation has enough energy to ionize atoms or molecules while non-ionizing radiation does not. Radioactive material is a physical material that emits ionizing radiation.

RESPONSIBILITY TO PROTECT (R2P): R2P is a recently developed concept in international relations which relates to a State’s responsibilities towards its population and to the international community’s responsibility in case a State fails to fulfill its responsibilities. One important aim, among others, is to provide a legal and ethical basis for “humanitarian intervention”: the intervention by external actors (preferably the international community through the UN) in a State that is unwilling or unable to prevent or stop genocide, massive killings and other massive human rights violations.

RADIOACTIVE WASTE: Radioactive wastes are waste types containing radioactive chemical elements that do not have a practical purpose. They are sometimes the products of nuclear processes, such as nuclear fission.

Reforestation is the restocking of existing forests and woodlands which have been depleted, with native tree stock.[1] The term reforestation can also refer to afforestation, the process of restoring and recreating areas of woodlands or forest that once existed but were deforested or otherwise removed or destroyed at some point in the past. The resulting forest can provide both ecosystem and resource benefits and has the potential to become a major carbon sink.

RICHTER SCALE: The Richter magnitude scale, or more correctly local magnitude ML scale, assigns a single number to quantify the amount of seismic energy released

by an earthquake. It is a base-10 logarithmic scale obtained by calculating the logarithm of the combined horizontal amplitude of the largest displacement from zero on a Wood–Anderson torsion seismometer output. So, for example, an earthquake that measures 5.0 on the Richter scale has a shaking amplitude 10 times larger than one that measures 4.0. The effective limit of measurement for local magnitude is about $ML = 6.8$.

RISK: is a concept that denotes a potential negative impact to some characteristic of value that may arise from a future event, or we can say that “Risks are events or conditions that may occur, and whose occurrence, if it does take place, has a harmful or negative effect”.

Exposure to the consequences of uncertainty constitutes a risk. In everyday usage, risk is often used synonymously with the probability of a known loss.

RISK ANALYSIS:

Probabilistic risk assessment (PRA) (or probabilistic safety assessment/analysis) is a systematic and comprehensive methodology to evaluate risks associated with a complex engineered technological entity (such as airliners or nuclear power plants).

Risk in a PRA is defined as a feasible detrimental outcome of an activity or action.

SPECIES EXTINCTION: In biology and ecology, extinction is the cessation of existence of a species or group of taxa. The moment of extinction is generally considered to be the death of the last individual of that species (although the capacity to breed and recover may have been lost before this point). Because a species' potential range may be very large, determining this moment is difficult, and is usually done retrospectively. This difficulty leads to phenomena such as Lazarus taxa, where a species presumed extinct abruptly "re-appears" (typically in the fossil record) after a period of apparent absence.

THERMAL POLLUTION: Thermal pollution is a temperature change in natural bodies of water caused by human influence. The temperature change can be upwards or downwards.

TORNADO: A tornado is a violent, rotating column of air which is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Tornadoes come in many sizes but are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris.

TOXIC WASTE: Toxic waste is waste material, often in chemical form that can cause death or injury to living creatures. It usually is the product of industry or commerce, but comes also from residential use, agriculture, the military, medical facilities, radioactive sources, and light industry, such as dry cleaning establishments. -

TRIAGE: A rapid method utilising simple procedures to sort affected persons into groups, based on the severity of their injury and/or disease, for the purpose of expediting clinical care to maximise the use of available clinical services and facilities.

TSUNAMI: A tsunami (pronounced) is a series of waves created when a body of water, such as an ocean, is rapidly displaced.

VOLCANO: It is an opening, or rupture, in a planet's surface or crust, which allows hot, molten rock, ash, and gases to escape from below the surface. Volcanic activity involving the extrusion of rock tends to form mountains or features like mountains over a period of time.

VULNERABILITY: Vulnerability is the susceptibility to physical or emotional injury or attack. It also means to have one's guard down, open to censure or criticism; assailable. Vulnerability refers to a person's State of being liable to succumb, as to persuasion or temptation (*see Thywissen 2006 for a comparison of vulnerability definitions*).

WATER POLLUTION: It is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to organisms and plants which live in these water bodies.

Annexure – VIII

Technical Terms and Measures of Radioactive Substances

Radiation Dose: Amount of energy delivered to a unit mass of material by the radiation travelling through it.

Absorbed Dose: Absorbed dose, D , is defined as the mean energy imparted by ionizing radiation to the matter in a volume element divided by the mass of the matter in that element

$$\text{Absorbed dose, } D = \frac{dE}{dm}$$

Unit of absorbed dose is Rad. One Rad deposits an energy of 100 ergs in one gram of tissue. The SI unit of absorbed dose is Gray (Gy) which is equivalent to deposition of 1 Joule per Kg (J/Kg) of tissue.

Equivalent Dose: Equivalent dose for a given type of radiation R , in a tissue or organ is the absorbed dose in gray multiplied by the corresponding radiation

When the radiation field is composed of different radiation types with different values of W_R , the equivalent dose is:

$$H_T = \sum_R W_R \cdot D_{T,R}$$

Where $D_{T,R}$ is the absorbed dose delivered by radiation type R to tissue or organ T , and H_T is equivalent dose in tissue T .

The unit of equivalent dose is $J \cdot kg^{-1}$, termed the Sievert (Sv). Old unit of equivalent dose is Rem.

$$100 \text{ Rem} = 1 \text{ Sv.}$$

Gray (Gy): The special name for the SI unit of absorbed dose: $1 \text{ Gy} = 1 \text{ J} \cdot \text{Kg}^{-1}$

Effective Dose: The quantity E , defined as a summation of the tissue equivalent doses, each

multiplied by the appropriate tissue weighting factor W_T .

$$E = \sum_T W_T H_T$$

where H_T is the equivalent dose in tissue T and w_T is the tissue weighting factor for tissue T.

The unit of effective dose is $J \cdot kg^{-1}$, termed the Sievert (Sv). Old unit of effective dose in Rem.

$$100 \text{ Rem} = 1 \text{ Sv}$$

It is important to note that most of the dose control units are given in terms of effective dose.

Sievert (Sv): The new SI unit for equivalent dose is Sievert (Sv).

$$1 \text{ Sievert} = 1 \text{ J} \cdot \text{Kg}^{-1}$$

Roentgen

Before the SI system was adopted, the unit of X-ray exposure was called the Roentgen and was symbolised by R. It is different from the absorbed dose. Roentgen is defined as that quantity of X or gamma radiation that produces ions carrying one stat coulomb (one electrostatic unit) of charge of either sign per cubic centimeter of air at 0°C and 760 mm Hg.

Radiation Weighting Factor: The Radiation Weighting Factor is an ICRP multiplier used to modify the absorbed dose (Gy) to obtain a quantity called the equivalent dose (Sv). It is used because some types of radiation, such as alpha particles, are more biologically damaging internally than other types such as the beta particles. For example, radiation weighting factor of beta particles is 1 while that of alpha particles is 20.

Radiation Weighting factors are dimensionless multiplicative factors used to convert physical dose (Gy) to equivalent dose (Sv); i.e., to place biological effects from exposure to different types of radiation on a common scale.

Tissue Weighting Factor: The tissue weighting factor is an ICRP multiplier used to determine the effective dose from the equivalent dose in one or more organs or tissues. The factor takes account of the different sensitivities of different organs and tissues for induction of stochastic effects from exposure to ionising radiation (principally, for

induction of cancer). For example, tissue weighting factor of lungs is 0.12 while that of liver is 0.05. Tissue weighting factors for the entire body as whole is 1, meaning, thereby, that the weighting factor is unity when the body is irradiated uniformly.

Committed Equivalent Dose $H_T(\tau)$: Following an intake of radioactive material, into the body, there is a period during which the material gives rise to equivalent doses in the tissues of the body at varying rates. The time integral of the equivalent-dose rate is called the committed equivalent dose, $H_T(\tau)$ where τ is the integration time (in years) following the intake. If τ is not specified, it is implied that the value is 50 years for adults and from intake to age 70 years for children.

Committed Effective Dose $E(\tau)$: The quantity $E(\tau)$, defines as:

$$E(\tau) = \sum_T w_T H_T(\tau)$$

where $H_T(\tau)$ is the committed equivalent dose to tissue T over the integration time τ and w_T is the tissue weighting factor for tissue T. When τ is not specified, it will be taken to be 50 years for adults and to age 70 years for intakes by children.

Dose limit

The value of the effective or equivalent dose to individuals that shall not be exceeded from planned exposure situations.

Measurement of External Dose

There are many devices and methods used to measure external exposure due to ionizing radiation. They can be grouped into two categories: dosimeters, and radiation detectors. Though less straightforward, there are also methods of detecting internal exposure to radiation.

Dosimeters

Dosimeters are devices that monitor an individual's external radiation dose. The two most commonly used dosimeters are Thermoluminescent Dosimeters (TLDs) and Direct Reading Dosimeters (DRDs). DRDs are also called pocket dosimeters. Both devices measure the dose accumulated over a given period of time. For example, TLD might be worn for a month. When it is collected and analyzed, the total exposure for that month can be determined.

While TLD measures a workers dose over an extended period of time, pocket dosimeter measures a worker's radiation dose each day. Rather than waiting for weeks, pocket dosimeter can detect whether a worker has received a dangerous dose during a given workshift. In principle, one should wear a TLD and a pocket dosimeter at the same time. Pocket dosimeters look like pens, and are clipped onto a shirt pocket.

Measurement of Internal Dose

External monitoring devices, such as TLDs, cannot measure the internal radiation dose due to radionuclides taken into the body through inhalation, ingestion, or other means. It is generally much harder to estimate doses from substances inside the body. The size of an internal dose will depend on the chemical form of the material, its pathways and distribution in the body, and the rate of its elimination from the body (called biological half-life), among other factors.

Internal doses can be monitored in various ways. One common way is to measure radionuclide concentrations in urine, and then based on the bio-kinetic model of a radionuclide radiation dose is inferred.

Another method is to measure the gamma radiation being emitted by the radionuclide inside the body. A portion of gamma radiation penetrates the body and escape outside it. This is measured by putting the worker or part of his or her body into a "counter," that measures gamma radiation. Thus, we have "whole body counters," "lung counters" etc.

Internal doses to workers can also be assessed indirectly by measuring the concentrations of radionuclides in the air in the workplace.

Beta and Gamma Radiation Detectors

Radiation detectors are devices used to detect alpha, beta and gamma radiation in air. They differ from dosimeters in that they can measure radiation directly, in real time. Most radiation detectors detect the interaction of radiation with gas molecules. Due to this interaction the gas molecules are ionized. In a Geiger-Müller Counter, this ionization produces a constant output electrical pulse, regardless of the amount of energy deposited in the detector or the nature of the ionizing radiation. On the other hand, the output of scintillation counters and gas flow proportional counters is proportional to the amount of energy deposited in the detector. When gamma rays pass through the scintillator, they produce electrons which in turn behave just like beta particles and convert some of their energy into light. Now a days semiconductor detectors are also available which have

advantage of small size and better resolution.

Alpha Radiation Detectors

Like beta and gamma radiation, alpha particles can produce ionizations, but they are not as penetrating, thus more difficult to detect. In principle, alpha particles could be detected with an ordinary GM tube. Alpha particles are best measured by what are called gas flow proportional counters or using ZnS(Ag) scintillators.

Hand-held instruments that measure alpha, beta and gamma radiation (in terms of the amount of ionization they produce) combined with readings in counts per minute or milliroentgens per hour are commercially available.

Contact Us

For more information on *Hand Book for Capacity Building of Civil Defence and Sister Organisations*

Please contact:

Sh. J.K. Sinha, IPS (Retd.)

Member

National Disaster Management Authority
NDMA Bhawan, A-1 Safdarjung Enclave,
New Delhi-110 029

Tel: +91-11-26701740

Fax +91-11-26701754

Email: jk_sinha2001@yahoo.com

Web: www.ndma.gov.in

PREPARED Communities SECURED Country

The Hand Book is designed to meet the increasing need for training a critical mass of master trainers. It covers various aspects of disaster preparedness and management in a user friendly manner supported by a large number of learning aids. It is a flexible structure so that each section can be detached, further developed and used as an autonomous unit and a standalone module for a particular clientele.

Organisations like Civil Defence need adequate number of competent, proactive, committed and highly skilled persons to work in an open, informed, participatory environment with focus on team work. Only training and retraining on regular basis could promote such professional, attitudinal and behavioural changes. It can sustain their interest, level of motivation and keep them connected with the cause and the community.

