Government of the People's Republic of Bangladesh

CONTINGENCY PLAN FOR EARTHQUAKE HAZARD
for Titas Gas Transmission & Distribution Company Limited (TGTDCL)

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Government of the People's Republic of Bangladesh

Contingency Plan for Earthquake Hazard

Under Comprehensive Disaster Management Programme (CDMP)
Ministry of Food and Disaster Management
Earthquake and Tsunami Preparedness
CDMP/EC/4a/PC-1

UNDP Bangladesh

DFID Department for International Development

CDMP Comprehensive Disaster Management Programme

List of Abbreviations

ADB	Asian Development Bank
AFD	Armed Forces Division
AMI	Anjumane Mofidul Islam Bangladesh
Ansar & VDP	Bangladesh Ansar and Village Defence Party
BA	Biman Airlines
BDR	Bangladesh Rifles
BCAA	Bangladesh Civil Aviation Authority
BCG	Bangladesh Coast Guard
BDRCS	Bangladesh Red Crescent Society
BFRI	Bangladesh Forest Research Institute
BGSL	Bakhrabad Gas Systems Limited
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BIP	Bangladesh Institute of Planners
BIWTA	Bangladesh Inland Water Transport Authority
BKMEA	Bangladesh Knitwear Manufacturer and Exporters Association
BLRI	Bangladesh Livestock Research Institute
BMA	Bangladesh Medical Association
BMD	Bangladesh Meteorological Department
BP	Bangladesh Police
BPDB	Bangladesh Power Development Board
BR	Bangladesh Railway
BRTA	Bangladesh Road and Transport Authority
BRTC	Bangladesh Road and Transport Corporation
BSS	Bangladesh Sangbad Sangstha
BTMEA	Bangladesh Textile Mills Association
BTCL	Bangladesh Telecommunication Company
BTRC	Bangladesh Telecommunication Regulatory Commission
BTV	Bangladesh Television
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CAAB	Civil Aviation Authority Bangladesh
CBOs	Community-Based Organizations
CC	City Corporations
CCP	Bangladesh Centre for Communication Programs
CDA	Chittagong Development Authority
CDC	Communicable disease Control
CME	Centre for Medical Education
CMMU	Construction, Maintenance and Management Unit
CPA	Chittagong Port Authority
CPP	Cyclone Preparedness Programme
CWASA	Chittagong Water Supply and Sewerage Authority
DCC	Dhaka City Corporation
DESA	Dhaka Electricity Supply Authority
DESCO	Dhaka Electric Supply Company Ltd.
DFP	Department of Films and Publications
DG Fisheries	Directorate of Fisheries
DGoF	Directorate General of Food
DG Livestock	Directorate of Livestock
DGHS	Directorate General of Health Services
DMB	Disaster Management Bureau

DMC	Department of Mass Communication
DOA	Department of Architecture
DPHE	Bangladesh Department of Public Health Engineering
DRR	Directorate of Relief and Rehabilitation
DWASA	Dhaka Water Supply and Sewerage Authority
EMS	Earthquake Magnitude Scale
FAO	Food and Agricultural Organization
FBCCI	Federation of Bangladesh Chambers of Commerce
FSCD	Bangladesh Fire Service & Civil Defence
IAB	Institute of Architects Bangladesh
IFRC	International Federation of Red Cross and Red Crescent Societies
IOM	International Organization for Migration
IRC	International Rescue Committee
JICA	Japan International Cooperation Agency
GSB	Geological Survey of Bangladesh
HBRI	Housing & Building Research Institute
IAB	Institute of Architects Bangladesh
IEB	Institute of Engineers Bangladesh
IFRC	International Federation of Red Cross and Red Crescent
INGOs	International Non-Government Organizations
JGTDSL	Jalalabad Gas Transmission & Distribution Co. Limited
LGA	Local Government Agencies
LGD	Local Government Division
LGED	Local Government Engineering Department
LGRD	Local Government and Rural Development
LGRDC	Local Government Rural Development and Cooperatives
MinCom	Ministry of Commerce
MoC	Ministry of Communications
MoCAT	Ministry of Civil Aviation and Tourism
MoF	Ministry of Finance
MoFDM	Ministry of Food and Disaster Management
MoFL	Ministry of Fisheries and Livestock
MoHA	Ministry of Home Affairs
MoHFW	Ministry of Health and Family Welfare
MoHPW	Ministry of Housing and Public Works
MoI	Ministry of Information
MoL	Ministry of Land
NGOs	Non-Government Organizations
NHA	National Housing Authority
NIPSOM	National Institute of Preventive and Social Medicine
OHCHR	Office of the High Commissioner for Human Rights
PDB	Power Development Board
PetroBangla	It is a successor of Bangladesh Mineral Oil and Gas Corporation
PGCL	Power Grid Company of Bangladesh Ltd
PIB	Press Institute of Bangladesh
PID	Press Information Department
PSTN	Public switched telephone Network
PWD	Public Works Department
R&H	Roads and Highways
RAB	Rapid Action Battalion
REB	Rural Electrification Board
RAJUK	Rajdhani Unnyan Kortipakha
REHAB	Real Estate & Housing Association of Bangladesh
RHD	Roads and Highways Department

TGTDCL	Titas Gas Transmission and Distribution Co. Ltd
SoB	Survey of Bangladesh
UNDP	United Nations Development Programme
UN HABITAT	United Nations agency for human settlements
UNHCR	UN High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNRC	Resident Coordinator of United Nations
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
VDP	Village Defence Party
WFP	World Food Programme
WHO (DERG)	World Health Organization (Disaster Emergency Response Group)

Executive Summary

This contingency plan is developed by Titas Gas Transmission & Distribution Company Limited (TGTDCL). Technical support for its preparation was provided by Asian Disaster preparedness Centre (ADPC) and National Society for Earthquake Technology-Nepal (NSET) as a part of **"Contingency planning with regards to Earthquake Hazards"** sub-component of Earthquake and Tsunami Preparedness Component of Comprehensive Disaster Management Program (CDMP) under implementation by the Ministry of Food and Disaster Management (MoFDM), the Government of Bangladesh (GoB) with the support from the United Nations Development Programme (UNDP), UK Department for International Development – Bangladesh (DFID-B) and the European Commission (EC).

This plan is an outcome of a series of interactions, workshops and meetings conducted among the staff of TGTDCL as well as interagency workshops and meeting conducted during the process. It is risk based contingency plan based on the earthquake loss estimation recently conducted. Once the loss maps and the targeted scenario is changed, some modifications in terms of human resources, materials and cost needs modification accordingly.

Two main objectives of this contingency plan are to:

- Make system of shutting down all the gas distribution to control fire just after the earthquake
- Provide emergency Gas to the evacuated people in immediate shelter area and
- Quick restoration of the Gas system after an earthquake

The specific objectives are:

- Vulnerability assessment of gas pipelines and compressor station
- Rapid Damage Assessment
- Restoration of utilities
- Rehabilitation and recovery planning for utilities
- Actions to control fire outbreaks, environmental hazards etc

For the gas system the first action after the earthquake is to shut off all the gas immediately. If the automatic shut off valves are not activated, they need to shut off manually. Irrespective of the damage state, it is planned shut off all the major valves immediately. Gas System Pipeline Repair Need with Valves is prepared in GIS map for facilitating this process.

The total number of displaced population needing shelter has been estimated at around 870,000 within the Dhaka city during scenario earthquake. This is estimated as 50% of the displaced people need immediate shelter after the earthquake and the remaining 50% will manage their shelter in their relatives and other places. Open

spaces within the City Corporation area that are more than 2500 square meters (Area with capacity for sheltering 500 families or more) are mapped and their shelter capacities are calculated. The total open spaces within the Dhaka city have only about ¼ capacity of the total population needing shelter.

The population evacuated in immediate shelter requires about cooking gas for about 56,200 families in the open spaces inside Dhaka City Corporation area. Total Population needing Evacuation Shelter is about 870,000 so the immediate shelter needing population exceeded the open space capacity within Dhaka City Corporation area is 616822 and need to be provided with immediate shelter in the shelter camps near to City Corporation. The numbers of families needing evacuation from Dhaka City Corporation area to the evacuation spaces outside city for the immediate shelter are about 137,000 and they require the immediate cooking gas.

So the arrangement of cooking gas for about 200,000 families is the main challenge during immediate response. At the same time, almost all of the gas line will be out of order and there will be an enormous demand from the public for the GAS.

GIS map with the numbers of families in different evacuation shelter is prepared to facilitate the Pre-positioning of this amount of GAS before earthquake.

The total number of skilled/trained workers required for repairing the Gas pipeline is about 280 per day repair the system within 7 days. If it is planned to repair in 14 days, it require about 140 skilled workers per day. This calculation is based on the assumption mentioned above; it can be updated in the availability of detail information.

Skilled workers required to repair compressor stations is not calculated here, as it require more number of people depending on the level of damage.

The total estimated cost require for repairs is about 1.5 Million US Dollars. The equipment and materials are not detailed and requires further detailing during plan revision.

Legal provisions and organizational set up, functional response roles and responsibilities assigned for the agency, operating procedures guideline and readiness checklists are also outlined in this plan.

Introduction

1.1 Creation of the Plan

This contingency plan is developed by Titas Gas Transmission & Distribution Company Limited (TGTDCL). Technical support for its preparation was provided by Asian Disaster preparedness Centre (ADPC) and National Society for Earthquake Technology-Nepal (NSET) as a part of **"Contingency planning with regards to Earthquake Hazards"** sub-component of Earthquake and Tsunami Preparedness component of Comprehensive Disaster Management Program (CDMP) under implementation by the Ministry of Food and Disaster Management (MoFDM), the Government of Bangladesh (GoB) with the support from the United Nations Development Programme (UNDP), UK Department for International Development – Bangladesh (DFID-B) and the European Commission (EC).

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1.2 Objectives of the Plan

Two main objectives of this contingency plan are to:

- Make system of shutting down all the gas distribution to control fire just after the earthquake
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- Quick restoration of the Gas system after an earthquake

The specific objectives are:

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- Rapid Damage Assessment
- Restoration of utilities
- Rehabilitation and recovery planning for utilities
- Actions to control fire outbreaks, environmental hazards etc

1.3 Planning Assumptions

This contingency plan has been developed with following assumptions in the background:

- The gas supply system of the Dhaka city will be out of function if there is an earthquake
- TGTDCL offices and staff will start working for providing services to the people just after the earthquake
- Capacity of the systems after the earthquake will not be sufficient and need extra preparations beforehand
- Large numbers of persons (hundreds of thousands) will be in need of cooking gas and gasoline including other facilities

- Access will be severely restricted due to debris, and collapsed bridges etc.

1.4 Intended Users of the Plan

The direct users of this Earthquake contingency plan will be the management personnel of Titas Gas Transmission & Distribution Company Limited (TGTDCL) in order to provide natural gas services to the people of Dhaka city during immediate response and early recovery phase after an earthquake. The plan also covers the preparedness actions before earthquake for effective response afterwards.

In addition to TGTDCL, the others such as line Ministries, Departments, City Authorities, NGOs/ INGOs, electronic and paper Media, Community based Organizations (CBOs), Civil Society Organizations (CSOs), Academia; Development Partners will be the passive users of the plan as they will be providing support services for plan implementation with regard to emergency services. The ultimate beneficiaries would be the communities at risk to bring normalcy within a fastest possible time.

1.5 Plan Implementation Strategies by the Agency

The following strategies are to be adopted in plan implementation:

- Setting up a strong organizational framework to identify and assess earthquake hazards, analyze vulnerability , assess risk and loss estimation with regards to natural gas system;
- Plan & development of institutional capabilities to translate earthquake risk reduction into Preparedness and Response Plans;
- Establish a consistent, participatory approach to the management of earthquake emergency responses;
- Undertake training and education programs on all phases of Disaster Management for all levels to build the capacity of professionals;
- Develop a mechanism to improve the relationships with non-government organizations to address mitigation, preparedness, response and recovery phase effectively;
- Transfer knowledge and state of the art of technologies necessary to support institutional operations and implement operation plans;

1.6 Plan Limitations

Following limitations are noted when this plan is drafted:

- This plan do not address all aspects of earthquake risk management (e.g. long-term recovery plans)
- The Plan assumes that the line agencies will have Mandatory provisions and national capacity to deal with assigned tasks. Mandatory provisions for line agencies, ministries, and local governments. District authorities can be granted through a gazette notification but Lines of authority need to be finalized and communicated to all levels.
- TGTDCL may need additional resources in terms of qualified manpower, technical as well as financial resources to undertake assigned tasks under the Earthquake Contingency Plan.

- The Earthquake Contingency Management process will take some time to become fully functional as an integrated system.
- The plan is based on earthquake loss estimation results obtained during the preparation of this plan and need verification when the final scenario is prepared
- The seismic assessment of the different components of the system are done as a part of the city risk assessment and require detail assessment for earthquake risk reduction planning

Earthquake Hazard, Vulnerability and Risk Assessment of Water and Sanitation System for Contingency planning

Earthquake risk assessment of the water and sanitation system was carried out under earthquake hazard, vulnerability and risk assessment component of CDMP project is taken as the base for the Contingency planning purpose. The loss estimation depends on the vulnerability assessment of the system as well as the expected hazards. As the study on hazard and vulnerability studies are still in the phase of revisions, the loss estimation team may arrive to new conclusions on total loss estimations.

This plan has used the loss estimation results that were available when the plan was created and subjects to revision when the new loss estimation is available.

The vulnerability and loss estimation results on water and sanitation system available from the earthquake hazard, vulnerability and risk assessment component for the Contingency planning is given in Section 2.1, Section 2.2 and Section 2.3 of this chapter.

2.1 Earthquakes Hazard Assessment

2.1.1 Earthquakes Hazard in Bangladesh

The combination of high disaster events as well as increasing human vulnerability resulting from demographic pressure, poverty, social inequality and coupled with the apprehended climate change indicate that Bangladesh is, currently, at high risk to large scale disasters with consequent impact on shelter, food, health and survival. Bangladesh is also susceptible to damaging earthquakes. It is a fact that during the recent past no major earthquake has occurred in Bangladesh or within its neighborhood but records indicates that during the past few hundred years there have been several significant earthquakes recorded within Bangladesh. Reliable historical data for seismic activity affecting Bangladesh is available only for the last 450 years (Gupta et. al. 1986).

Recently developed earthquake catalogue for Bangladesh and surrounding areas (Sharfuddin, 2001) shows 1200 earthquakes with a magnitude (Ms) of 4.0 have occurred between 1885 and 1995, within a 200 km radius of Bangladesh.

Site dependent seismic motion and damage, caused by specific soil conditions and other characteristics is an important characteristic in seismic hazard assessment. It can provide inputs to Micro-zonation studies as well as to determine the overall seismic risk in the built environment. This facilitates the preparation of the earthquake emergency plans and also to improve the preparedness and mitigation of earthquake and tsunami risk with a view to strengthen the capacity of the city dwellers of major cities to face, manage the emergencies and reduce the impact and economic losses through better preparedness measures undertaken as a long term measure.

The earthquake risk of the urban centre grows with every passing moment because of the unabated growth of human settlement and industrial and other economic activities. Disastrous effects of earthquakes in high density areas even far from the epicentral tracts can be quantified now through scenario based studies, and it opens up the opportunity to create knowledge products for large urban areas like Dhaka, Chittagong and other urban centre.

Figure 1 gives the main fault system in and around Bangladesh that can have severe in Bangladesh.

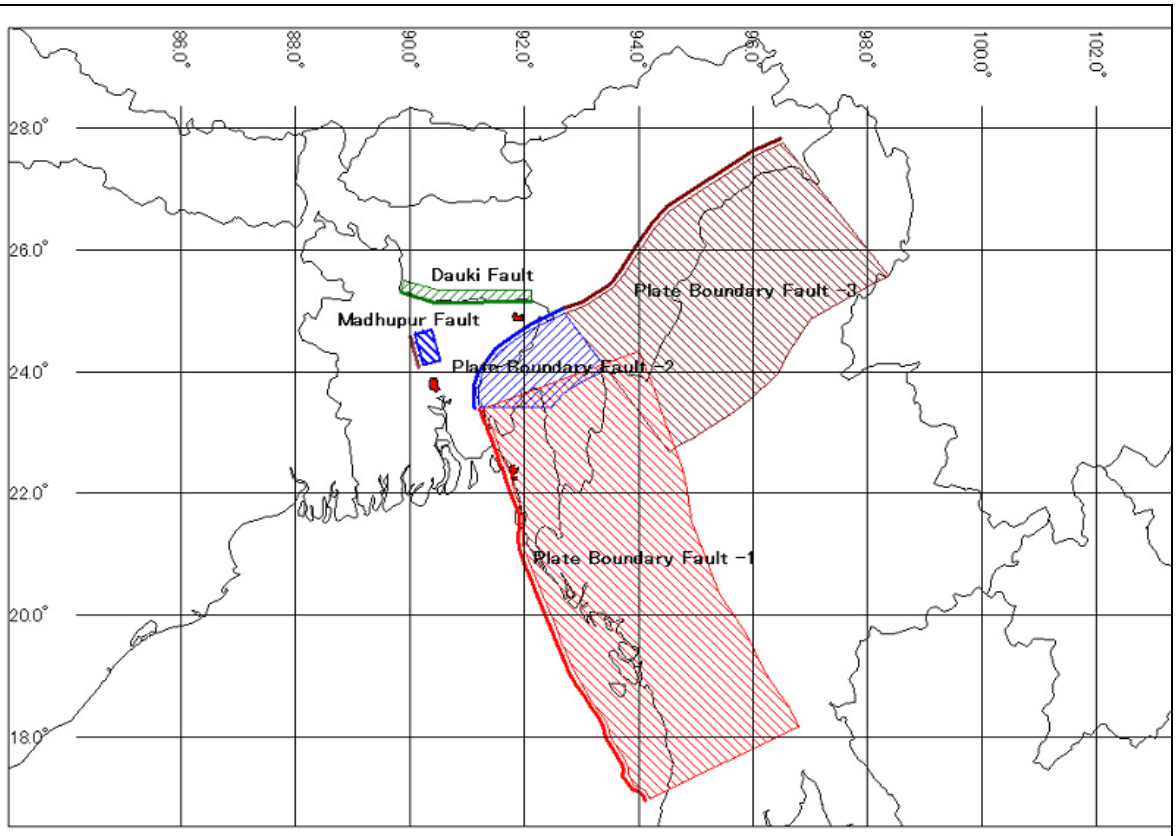


Figure 1: Earthquake Fault Zones in and around Bangldesh

Different parameters of the fault systems are given in Table 111.

Table 1-1 Fault Parameters for Empirical Attenuation Analysis

Fault	Mw	Depth to top of fault (km)	Dip (degree)	Down-dip rupture width (km)	Fault Type
Madhupur Fault (MF)	7.5	10	45	42	Reverse
Dauki Fault (DF)	8.0	3	60	43	Reverse
Plate Boundary Fault -1 (PBF-1)	8.5	3	20/30	337	Reverse
Plate Boundary Fault -2 (PBF-2)	8.0	3	20	137	Reverse
Plate Boundary Fault -3 (PBF-3)	8.3	3	20/30	337	Reverse

2.1.2 Earthquake Hazard in Dhaka City

The ADPC and partners hazard assessment team under the CDMP project studied the seismic hazard of three cities, Dhaka, Chittagong and Sylhet. In case of Dhaka, the PGA, PGV and Sa (h=5%, T=0.3 and 1.0 sec) at ground surface were calculated for five scenario earthquakes. In this analysis, the effects of non linearity of soils were considered.

The most important earthquake is Madhipur Fault and the PGA in Dhaka is 220 to 410 gal. Figure 1-2 shows the PGA distribution map and Figure 1-3 gives the Liquefaction susceptibility map.

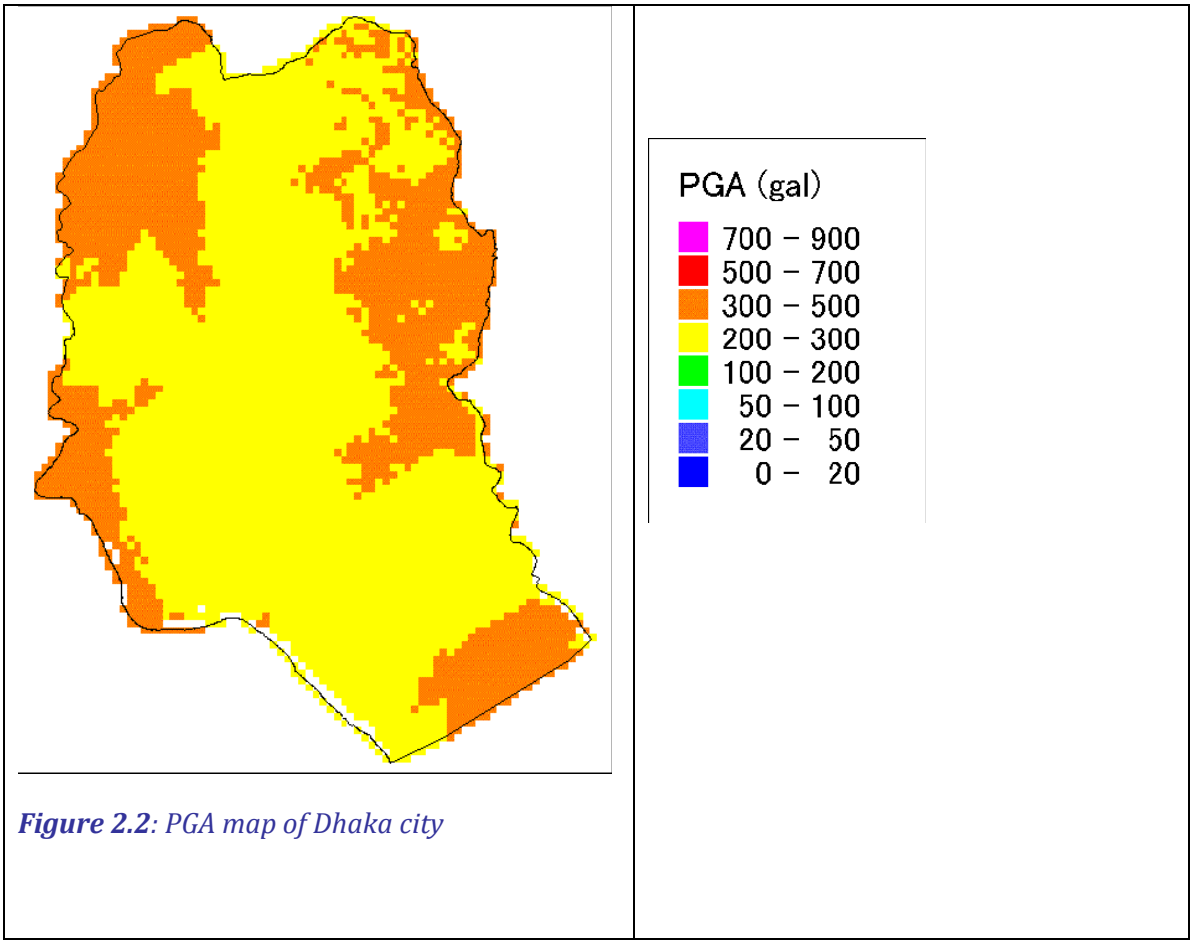


***Figure 2.2**: PGA map of Dhaka city*

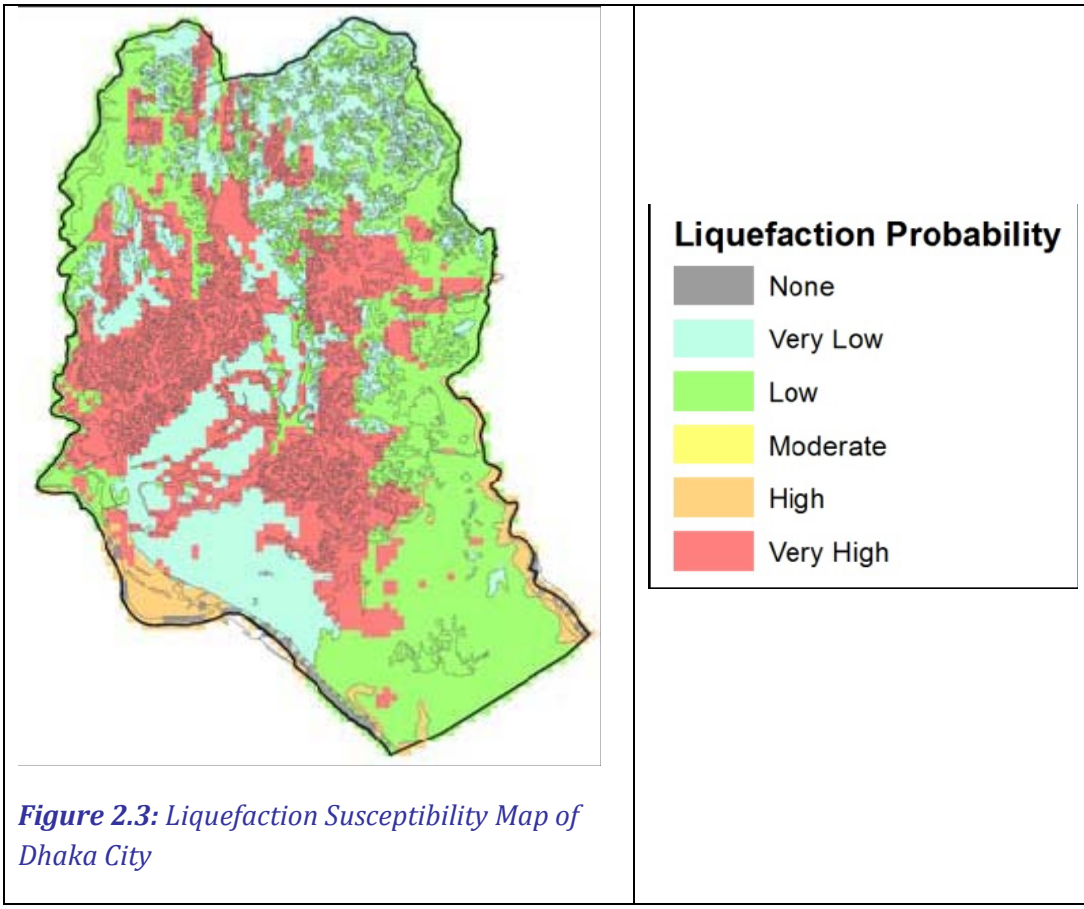


Figure 2.3: *Liquefaction Susceptibility Map of Dhaka City*

2.1 Vulnerability Assessment of Dhaka Gas System

Vulnerability is assessed from the characteristics of gas pipeline and distribution facilities that make them susceptible to the damaging effect of an earthquake. In gas system, vulnerability is identified from the pipe ductility type, distribution facility type, and soil liquefaction susceptibility on which the pipe and facility lie on. From the field survey, it is found that most of distribution facilities are not prepared with the seismic design, proper anchorage, and backup power system. From vulnerability assessment, natural Gas System consists of pipelines (NGP1/NGP2) and compressor stations (NGC). Both are vulnerable to damage during earthquake. Failure of natural gas system may cause another disaster of fire. The vulnerability is assessed from the characteristics of pipeline joints and distribution facilities that make them susceptible to the damaging effect of an earthquake. The gas pipeline is welded steel pipe, and the critical part is located at the joint. Based on the welding process, gas pipeline is divided into gas-welded joint (NGP1) and arc-welded joint (NGP2). From data acquisition, it is identified that gas pipelines in the 3 cities are with arc-welded joints. System vulnerability is identified from the pipe type and compressor station location relation to the soil liquefaction susceptibility on which they lie on. Pipeline and compressor stations located on higher liquefaction susceptibility soil is more vulnerable than those on low or none liquefaction susceptibility.

Table 2-1 Components of Natural Gas System of Dhaka City Corporation Area

No.	Component	Material	Length (km) or quantity
1.	Pipe diameter 0.5mm	Steel	*0.76*

2.	Pipe diameter 0.75mm	Steel	*98.66*
3.	Pipe diameter 1mm	Steel	*448.60*
4.	Pipe diameter 1.25mm	Steel	*2.31*
5.	Pipe diameter 1.5mm	Steel	*2.04*
6.	Pipe diameter 2mm	Steel	*503.36*
7.	Pipe diameter 3mm	Steel	*98.45*
8.	Pipe diameter 4mm	Steel	*86.78*
9.	Pipe diameter 6mm	Steel	*45.66*
10.	Pipe diameter 8mm	Steel	*95.48*
11.	Pipe diameter 10mm	Steel	*3.42*
12.	Pipe diameter 12mm	Steel	*34.51*
13.	Pipe diameter 14mm	Steel	*0.04*
TOTAL			*1,420.07*
14.	DRS	NA	*7*
15.	Valve	NA	*2344*

The following tables show the pipeline length and number of facilities in different liquefaction susceptibility soils and spatial distribution of natural gas components in 3 City Corporation areas.

Table 2-2 Natural Gas Pipe Length and Number of Facilities on Soil Liquefaction susceptibility in Dhaka City Corporation Area

Component	Liquefaction Susceptibility (length in km or number of facility)						Total
	None	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	
Pipeline							
Arc-welded Joint Steel Pipe	*0.00*	*581.96*	*2.08*	*124.21*	*0.26*	*711.57*	*1420.08*
Total	*0.00*	*581.96*	*2.08*	*124.21*	*0.26*	*711.57*	*1420.08*
Facility							
Compression Station (DRS)	*0*	*2*	*0*	*2*	*0*	*3*	*7*
Total	*0*	*2*	*0*	*2*	*0*	*3*	*7*

Table 2-3 Spatial Distribution of Natural Gas System Components in Each Ward of Dhaka City Corporation Area

Ward	**Arc-welded Joint Steel Pipe**	**Compression Station (DRS)**	**Ward**	**Arc-welded Joint Steel Pipe**	**Compression Station (DRS)**
1	*145.06*	*1*	32	*14.42*	
2	*35.09*		33	*8.91*	
3	*42.00*		34	*10.83*	
4	*12.31*		35	*8.39*	
5	*14.26*		36	*19.55*	
7	*0.62*		37	*21.26*	
8	*2.06*		38	*15.42*	
10	*18.52*		39	*17.13*	
11	*14.50*		40	*29.00*	
12	*10.12*		41	*4.01*	

Ward	Arc-welded Joint Steel Pipe	Compression Station (DRS)	Ward	Arc-welded Joint Steel Pipe	Compression Station (DRS)
13	*45.11*		42	*22.78*	
14	*33.86*	*1*	43	*23.79*	
15	*19.26*		44	*25.60*	
16	*44.52*		45	*27.79*	
17	*36.17*	*1*	46	*16.93*	
18	*26.29*		47	*10.81*	
19	*82.61*	*2*	48	*16.75*	
20	*14.54*		49	*36.02*	
21	*22.82*		50	*10.24*	
22	*70.89*		51	*9.60*	
23	*12.86*		52	*14.29*	
24	*20.60*		53	*25.81*	
25	*49.92*		54	*18.39*	
26	*8.32*		55	*6.87*	
27	*24.07*		56	*7.00*	
28	*9.48*		57	*5.28*	
29	*11.27*		58	*10.31*	
30	*3.89*		90		*1*
31	*10.00*		91		*1*
			Total	*1,278.21*	*7*

2.2 Earthquake Risk Assessment of Dhaka Gas System

Table 2-4 and Table 2-5 provide information on the damage to Gas utility lifeline systems. The estimated damage to the gas pipelines shows that there will be about 247 leaks and breakages to the gas pipeline system

Gas System pipeline repair need map is given in **Map 1** of **Annex II** and major Compressors Stations needing repairs is given in **Map 4** of **Annex II**.

Table 2-4 Calculated Gas Pipeline Damage in Dhaka City Corporation Area

Component	Total Length (km)	Total Losses (thou $)	Total leaks and breakages requiring Repairs
Pipeline	834	433	246

Table 2-5 Calculated Gas System Facility Damage in Dhaka City Corporation Area

Component	Total Number	Functionality Probability at Day 1			Total Losses **(thou $)**	Remark
		> 60%	**40%-60%**	**< 40%**		
Compressor Station	7	0	6	1	4000	

2.3 Overall Earthquake Damage Scenario of the City

Three different loss scenarios are studied by the risk assessment team for Dhaka city. The scenario 1, the loss due to Madhupur fault, is taken as the worst case scenario for the water and sanitation system Contingency planning. The risk analysis was conducted in HAZUS, risk assessment computer software.

HAZUS estimates that about 166,570 buildings will be at least moderately damaged. This is over 51.00 % of the total number of buildings in the region. There are an estimated 75,218 buildings that will be damaged beyond repair.

Table 2-5 Expected Building Damage by Occupancy Class in Dhaka City Corporation Area: Scenario case 1

Dhaka : Case 1

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	526	0.45	273	0.65	325	0.60	193	0.52	327	0.44
Commercial	16,271	13.80	5,028	11.88	7,738	14.26	6,198	16.71	11,533	15.33
Education	1,388	1.18	384	0.91	432	0.80	349	0.94	610	0.81
Government	330	0.28	117	0.28	168	0.31	129	0.35	170	0.23
Industrial	2,294	1.95	562	1.33	917	1.69	1,033	2.79	1,572	2.09
Other Residential	94,994	80.56	34,924	82.50	42,882	79.03	27,821	75.01	58,739	78.09
Religion	781	0.66	271	0.64	307	0.57	297	0.80	523	0.70
Single Family	1,340	1.14	770	1.82	1,491	2.75	1,072	2.89	1,744	2.32
Total	117,924		42,330		54,261		37,091		75,219	

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for two times of day: 2:00 AM and 2:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum and the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum.

Table 2-6 Summary of the casualties estimated for earthquake in Dhaka City Corporation Area : Scenario Case 1

Dhaka : Case 1					
		Level 1	**Level 2**	**Level 3**	**Level 4**
2 AM	Commercial	635	209	37	73
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	72	24	4	8
	Industrial	101	33	6	11
	Other-Residential	150,938	50,463	8,952	17,733
	Single Family	561	177	30	59
	Total	152,307	50,905	9,028	17,884
2 PM	Commercial	81,688	27,043	4,789	9,401
	Commuting	2	2	4	1
	Educational	3,590	1,176	208	405
	Hotels	14	5	1	2
	Industrial	744	244	43	84
	Other-Residential	51,351	17,279	3,166	5,979
	Single Family	194	62	11	20
	Total	137,582	45,810	8,221	15,892

Immediate Shelter Need:

The estimated displaced population will be about 1,700,000 and about half of them i.e. 870,000 need immediate shelter. So, all the relief materials like water, food, clothes etc. are needed for 870,000 of the people within Dhaka city.

2.4 Interrelationship with other Lifelines and Utilities

Transportation and lifeline infrastructure include road network, bridge, gas (natural gas) network, electric network, telephone network, water supply network, and sewerage network. Typically such lifeline systems are extended spatially over large areas and consist of numerous structures; they are related to urban lives and functions and are vulnerable to earthquake. In Dhaka, gas and water-sewerage connections still use either galvanized iron (GI) or concrete pipes. During an earthquake these are likely to breakdown very easily. Electrical service is also likely to collapse during and after an earthquake.

The major causes of post-earthquake fires include gas leaks due to failure of pipes or gas appliances; problems in the electrical distribution system; flammable materials; overturning of candles, lamps, cooking ovens, etc. Narrow roads in old town, garments and other manufacturing industries in dense residential areas of Dhaka are likely to create additional problems in the event of an earthquake.

Natural gas leaks and explosions are responsible for a significant number of fires following disasters. Electrical sparks in broken buildings and infrastructure have the potential of igniting the gas leaks from the ruptured pipeline. Fires break out initially and then spread to the surroundings depending on building construction, building density, wind, etc.

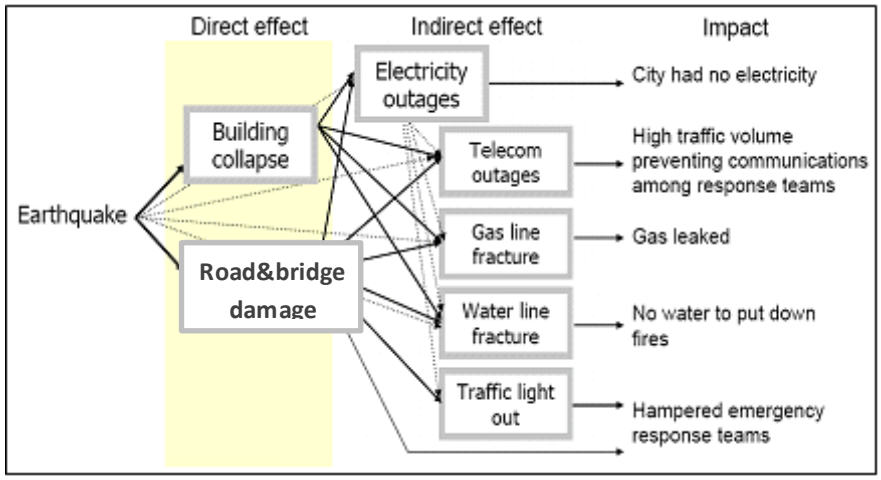


Figure 2.3: Effect and Impact of Earthquake toward infrastructure and lifeline

Effect and impact of an earthquake towards the transportation and lifeline infrastructure can be seen in (Figure 2.1). In emergency situation, management of those infrastructures form a complex relationships among various critical facilities and infrastructure elements, and result in infrastructure interdependencies as shown in

Plan for Immediate Response and Early Recovery

3.1 Key Activities of the Water and Sanitation Sector for Immediate Response and Early Recovery

One of the objectives of the shelter and utility planning cluster according to the national level contingency plan is **"Efficient restoration of utilities and services after earthquakes and prevent outbreak of fire due to malfunctioning of utilities".** The gas system contingency plan is within the shelter and utility planning cluster. **Table 3-1** gives the details on gas supply sector objectives, main tasks and activities, lead agencies and supporting agencies.

The main tasks assign for preparation of gas system contingency plan are:

1) Vulnerability assessment of gas pipeline compressor station

2) Rapid damage assessment

3) Restoration of utilities

4) Rehabilitation and recovery planning for utilities

5) Actions to control fire outbreaks, environmental hazards etc

Table 3-1: Details on Shelter and Utility Planning Sector in National Contingency Plan

<table>
<tr><th colspan="5">Cluster 5 - Shelter (Including setting up temporary shelter) and Utility Planning</th></tr>
<tr><td colspan="5">Responsible Ministry: Ministry of Food and Disaster Management</td></tr>
<tr><td colspan="5">Primary Responsibility: Disaster Management Bureau (DMB)</td></tr>
<tr><td colspan="5">Secondary Responsibilities: TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB,BTCL, Private Telecom Companies, Local Government Bodies</td></tr>
<tr><td colspan="5">Other Associated Agencies ; AFD, Donor agencies, Un Agencies, INGOS, NGOs</td></tr>
<tr><td colspan="5">Objectives:
To ensure efficient restoration of utilities and services after earthquakes such as supply of telecommunication facilities, power, gas and, waste disposal etc
To ensure temporary shelter for displaced after disaster events such as Earthquakes and provision of basic facilities to the same
To prevent outbreak of fire due to malfunctioning of utilities such as gas, electricity supply etc
To ensure prevention of environmental disorder due to release of hazardous waste and material</td></tr>
<tr><th colspan="2">Activities</th><th>Lead Agency/ Institution</th><th>Support Agencies/Institutions</th><th>Global Cluster Partner (Proposed)/Other associate agencies</th></tr>
<tr><td rowspan="2">Pre Disaster Functions and Agency Role</td><td>Conduct meetings with Utilities sub-committee for enhanced preparedness measures to be undertaken by Utility agencies to minimize impacts and to prevent malfunctioning of services during emergencies</td><td>DMB</td><td>TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB</td><td rowspan="2">Global cluster</td></tr>
<tr><td>Maintenance of stocks of most essential spare parts and service personal for attending to large scale emergencies such as earthquakes</td><td>Utility agencies</td><td></td></tr>
</table>

	Develop guidelines for vulnerability assessment of utilities and conduct training for Utility sector staff for undertaking vulnerability assessments	DMB	TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB	partners - IFRC, UNHCR IOM
	Capacity building of utility sector for Contingency planning and planning for restoration of facilities and Implement Response Capacity Assessment programs for reduction of impacts for Utility sector and develop efficient response capacity	DMB	TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB, City Corporations and Urban Local bodies	Others – NGO, INGO, BDRCS
	Design and implement projects for pre-positioning of emergency power supply services for critical areas	Local Govt. Bodies	TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB	
	Develop procedure for post earthquake damage assessment of all essential utilities within the city by utility managers	TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB	City Corporations and Urban Local bodies	
	Identification of all buildings(such as schools) which can be used as Temporary shelter and conduct capacity assessment survey for identification of needs	City Corporations and Urban Local bodies	Utility agencies	
	Provision of utility services for buildings identified as temporary Shelters, and maintain stocks of standby emergency shelter items/equipment for quick mobilization during establishment of temporary shelter(stand-by generators, Temporary camps etc)	City Corporations and Urban Local bodies	Utility agencies	
	Identification of all possible sources of Hazardous waste/hazardous material release during emergencies and conduct awareness programs to prevent environmental and societal impacts due to release of hazardous substance during emergencies such as earthquakes	City Corporations and Urban Local bodies	Relevant Industries, Business enterprises	
	Activities	**Lead Agency/ Institution**	**Support Agency**	**Global Cluster Partner (Proposed)/Other associate agencies**
During Disaster Functions and Agency Role	Immediately activate the Plan for shut off of all supplies of Gas, Electricity, Waste disposal etc at all shut off points.	Utility agencies/Local Government Bodies		Global cluster partners - IFRC, UNHCR IOM
	Utility agencies undertake restoration work and actions to rehabilitate supply of power, gas, etc to critical agencies(hospitals, AFD, Police, evacuation camps so on)	Utility agencies(TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB)/Local Government	AFD,FSCD, School, College, Universities, DMB, DRR,	

		Bodies		Others – NGO, INGO, BDRCS
	Conduct rapid damage assessment survey of power supply systems(generation, distribution, supply) and restoration of supply to critical facilities(such as hospitals, police, AFD, Fire Service etc) Organize project teams to conduct Rapid damage assessment of all essential utilities within the city by utility managers	Utility agencies(TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB)/ Local Government Bodies,	AFD, FSCD, Universities,	
	Mobilize pre-positioned emergency power supply services for critical areas	BPDB	DESA, DESCO, AFD, FSCD, Local Govt. Bodies, Universities, NGOs	
	Obtain periodic situation reports and review the progress on activation of Contingency Plans and restoration of services by utility agencies	DMB	TGTDCL, JGTDSL, BGSL, PGCL, DESA, DESCO, WASA, BPDB	
	Activities	**Lead Agency/ Institution**	**Support Agencies/Institutions**	**Global Cluster Partner (Proposed)/Other associate agencies**
After Disaster Functions and Agency Role	Conduct survey of Temporary shelter set up for IDPs for qualitative improvement of shelter for IDPs	DMB	DRR, AFD, Local Government Bodies, Academia, Professional bodies,	Global cluster partners - IFRC, UNHCR IOM Others – NGO, INGO, BDRCS
	Develop early recovery Plans for setting up new Settlement programs and rehabilitation of partially damage settlement and housing for supply of permanent shelter for affected.	DMB	Local Government Bodies, Academia, Professional bodies,	
	Conducting damage assessment survey of all utilities and prepare Plans for restore and rehabilitate supply of power, water, gas, to affected areas and in waste disposal	All Utility agencies	DMB,AFD, Local Government Bodies, Universities, PDB, Private Telecom Companies, TITAS, Utility agencies	
	Conduct damage assessment survey of power supply systems(generation, distribution, supply) and prepare estimates for restoration of supply to other areas , Preparation of Plans for rehabilitation	BPDB	Local Government Bodies, Universities, DESA, DESCO	
	Integrate mitigation and preparedness programs in Recovery Planning by utilities for reduction of future earthquake impacts during restoration of facilities	All Utility agencies	Local Government Bodies, Universities, PDB, Telecom, TITAS, Utility agencies	
	Assist in restoration of all essential utilities and services within the city by utility managers	Local Government Bodies	PDB, TITAS, WASA, DESA, Universities	
	Provide periodic situation reports on the status of restoration of services and	DMB, National	PDB, TITAS, WASA, DESA,	

	review the progress	EOC	Universities	
	Review the Performance of Cluster 5 - Shelter (Including setting up temporary Camps) and Utility Planning Cluster and introduce modifications to the Contingency Plan for better performance in future.	DMB, National EOC	Utility agencies, Local Government Bodies	

3.2 Immediate Response Plan

3.2.1 Control Fire

For the gas system the first action after the earthquake is to shut off all the gas immediately. If the automatic shut off valves are not activated, they need to shut off manually. Irrespective of the damage state, it is planned shut off all the major valves immediately.

Gas System Pipeline Repair Need with Valves is given in **Map 2** of **Annex II**.

3.2.1 Provide Emergency Gas in Immediate Shelter Camps

The total number of displaced population needing shelter has been estimated at around 870,000 within the Dhaka city during scenario earthquake. This is estimated as 50% of the displaced people need immediate shelter after the earthquake and the remaining 50% will manage their shelter in their relatives and other places. Open spaces within the City Corporation area that are more than 2500 square meters (Area with capacity for sheltering 500 families or more) are mapped and their shelter capacities are calculated. Area of different evacuation spaces, population holding capacities and the families needing cooking gas in different evacuation spaces are given in **Table 3-2** below. The total open spaces within the Dhaka city have only about ¼ capacity of the total population needing shelter.

Table 3-2: Requirement of Emergency Cooking Gas in Different Evacuation Spaces

Evacuation Space	Area_m2	Capacity	Families needing Immediate Cooking Gas
1	64157	7129	1584
2	59836	6648	1477
3	81509	9057	2013
4	677244	75249	16722
5	60265	6696	1488
6	128245	14249	3167
7	119715	13302	2956
8	809639	89960	19991
9	31132	3459	769
10	25125	2792	620
11	145079	16120	3582
12	32601	3622	805
13	44054	4895	1088
Total Population Evacuated in Open Spaces Inside Dhaka City Corporation Area		***253178***	**56262**

The population evacuated in immediate shelter requires about cooking gas for about 56,200 families in the open spaces inside Dhaka City Corporation area. Total Population needing Evacuation Shelter is about 870,000 so the immediate shelter needing population exceeded the open space capacity within Dhaka City Corporation area is 616822 and need to be provided with immediate shelter in the shelter camps near to City Corporation. The numbers of families needing evacuation from Dhaka City Corporation area to the evacuation spaces outside city for the immediate shelter are about 137,000 and they require the immediate cooking gas.

So the arrangement of cooking gas for about 200,000 families is the main challenge during immediate response. At the same time, almost all of the gas line will be out of order and there will be an enormous demand from the public for the GAS.

The numbers of families in different evacuation shelter are shown in **Map 3** of **Annex II**.

3.3 Early Recovery Plan

3.3.1 Human Resources, Materials and Cost Planning

Assumptions:

Human resources required for repair of Gas Pipeline:

2 days for 4 person crew to repair one break.

Human resources required for repair and construction of the other facilities depends on the size of the facilities. A group of about 10-20 skilled masons are required from a week to 6 months for repair and reconstruction of the distribution facilities.

Table 3-2 gives the required human resources and the repair plan for the gas system pipeline and **Table 3-3** gives the compressor stations repair plan.

Table 3-2 Expected Gas System Pipeline Repair Plan

Component	Total Length **(km)**	Total Losses **(thou $)**	Total Repairs	Number of Skilled Workers Required to Repair the Pipeline in			Repair Unit Cost **(thou $)**	Repair Cost **(thou $)**
				7 days	**14 days**	**30 days**		
Pipeline	834	433	346	281	141	66	0.69	170

Table 3-3 Expected Gas System Facilities Repair Plan

Component	Total Number	Total Losses **(thou $)**	Total Repairs	Number of Skilled Workers Required to Repair the Pipeline in			Repair Unit Cost **(thou $)**	Repair Cost **(thou $)**
				7 days	**14 days**	**30 days**		
Compressor Stations	7	1284	4				1000	1284

The total number of skilled/trained workers required for repairing the Gas pipeline is about 280 per day repair the system within 7 days. If it is planned to repair in 14 days, it require about 140 skilled workers per day. This calculation is based on the assumption mentioned above; it can be updated in the availability of detail information.

Skilled workers required to repair compressor stations is not calculated here, as it require more number of people depending on the level of damage.

The total estimated cost require for repairs is about 1.5 Million US Dollars. The equipment and materials are not detailed and requires further detailing during plan revision.

Functionality of Compressors Stations, Location of Gas Filling Stations and Gas Line for filling stations is given in **Map 5** of **Annex II**. The Gas System pipeline repair need is given in **Map 1** of **Annex II**.

3.3.2 Priorities for Early Recovery

The first priority after the immediate response is to start the recovery of the critical elements within the system. Following are the proposed priorities actions for effective recovery:

Priority 1: Repair Compressors

Priority 2: Repair Filing Stations Pipeline

Priority 3: Repair Main Pipelines

Priority 4: Repair Pipelines in Less Damage Areas

Priority 5: Repair Pipelines in other areas

Legal Provisions and Organizational Setup

4.1 Legal Provisions, Authority and national level DM Functions of the Agency

Organizational setup of the Titas Gas Transmission & Distribution Company Limited: The Managing Director, along with the Board of Members, of TGTDCL is responsible for Implementation of all Gas Transmission related programs & to provide technical guidance to the Ministry. Ten different Divisions are assigned to work under the Managing Director, TGTDCL.

With regard to Disaster Management, the Titas Gas Transmission & Distribution Company Limited is to provide efficient Gas transmission to all levels of victims.

4.2 The Major roles assigned to the agency in relation to National Earthquake Contingency Plan

The agency level responsibility of TGTDCL with regards to Earthquake Risk Management is to ensure management of situation of mass casualties and treatment of victims as a result of Earthquakes and major aftershocks and as a result of co-lateral hazards. The main roles assigned to TGTDCL in relation to National Earthquake Contingency Plan are to ensure:

- Assist Utility agencies to restore and rehabilitate supply of power, water, gas, etc to critical agencies (hospitals, AFD, Police, evacuation camps so on)
- Assist Utility agencies to restore and rehabilitate supply of power, water, gas, to affected areas and in waste disposal

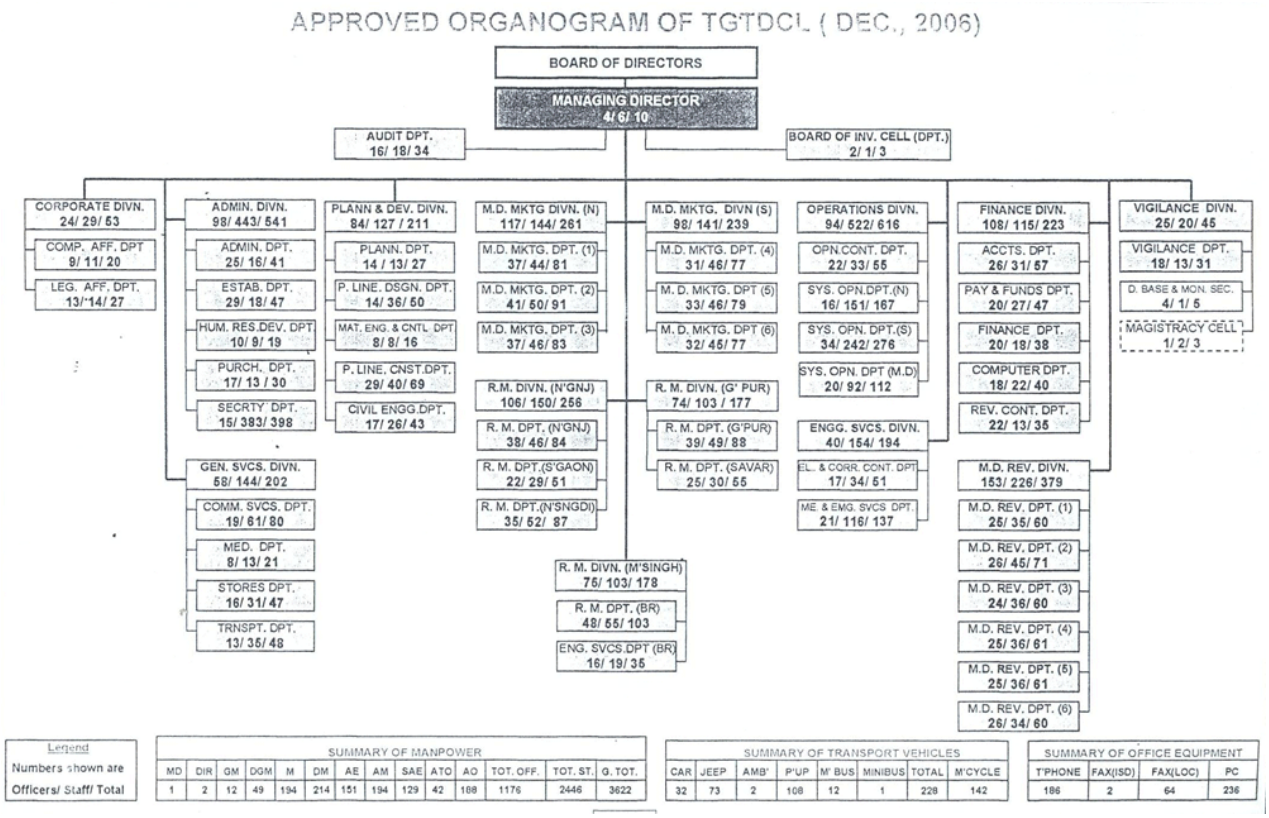
4.3 The support roles assigned to agency under National Earthquake Contingency Management Plan

A strong National Earthquake Contingency Plan is considered to be a one that is built on a foundation for DRM that promotes

- Appropriate Command and Control mechanism
- Efficient, effective collaboration & coordination
- Trust, mutual respect and understanding among all stakeholders
- Arrangements for sharing of resources and experience that will result in a highest level of safety and security of citizens of Bangladesh from Earthquakes at all times

4.4 Agency level structure for Command, Control and Coordination within the organization and with outside agencies

The Organogram of the Titas Gas Transmission & Distribution Company Limited is given as follows:



Command, Control and Coordination mechanism for TGTDCL with regard to Disaster Management are as follows:

Overall Supervision: Managing Director, Titas Gas Transmission & Distribution Company Limited

Focal Point: Director (Operations), TGTDCL

Management support: General Manager (Marketing)

Monitoring: General Manager (Planning)

The Response Action of TGTDCL can be expressed as under:

Initial Action: Managing Director calls Officials of TGTDCL and other concern Agencies

Continuing Action:

- Situation Assessment
- Activate & deploy of Medical Response Teams
- Coordination of Requests for medical Transportation/Ambulance
- Coordination of Requests for FSCD

Functional Response Roles and Responsibilities Assigned for the Agency

5.1 Emergency Response Tasks under Respective Functional Groups- Preparedness and Mitigation Phase (normal time activities)

To ensure this Contingency planning as a forward planning process, it is obvious to agree upon specific scenarios and objectives. An effective Potential Response System has to be put in place in order to prevent, or better respond to, an emergency or critical situation. In this regard, TGTDCL needs to accomplish the following activities well-before the earthquake event.

Activities related to Contingency planning

- Develop and regularly update contingency plan
- Conduct necessary training and capacity building for plan update
- Carry out periodic reporting to authorities on readiness of the sector for responding to earthquake events

Activities related to Gas Transmission

- Develop Contingency Plans for earthquake risk
- Conduct necessary training and capacity building for Plan update
- Carry out periodic reporting to authorities on readiness of the (TGTDCL) for responding to earthquake events

Activities related to Just-after Recovery Phase

- Develop procedures and guidelines for recovery projects in Gas Transmission facilities to reduce future damages
- Develop procedures for integrating seismic safety in recovery programs in Gas Transmission sector
- Develop capacity building programs for professionals to integrate seismic safety and improve preparedness

5.2 Emergency Response Tasks under Respective Functional Groups – Response phase (activities during and soon after the disaster events)

Activities related to Contingency planning

- Compliance with plan arrangements and reporting on the health sector involvement in providing health care to victims

Activities related to Gas Transmission

- Compliance with Plan arrangements and reporting on the (TGTDCL)involvement in Contingency Plan implementation
- Activate the alert system
- Organize project teams to conduct Rapid damage assessment of all essential utilities within the city by utility managers

- Obtain periodic situation reports and review the progress on activation of Contingency Plans
- Resource deployment for aid to injured and disposal of dead

5.3 Recovery phase (activities following a disaster event)

Activities related to Contingency planning

- Compliance with the plan arrangements and reporting on gas transmission sector involvement.

Activities related to Gas Transmission

- Organize project teams to conduct Detail damage assessment of all Gas Transmission infrastructure and prepare for recovery program implementation
- Develop guidelines for Gas Transmission systems for build better taking the impact of potential earthquakes

Activities related to Just-after Recovery Phase

- Assist in restoration of all essential utilities within the city by utility managers
- Obtain periodic situation reports and review the progress

Operating Procedure Guidelines

6.1 Planning assumptions

- The agency level responsibility of Utilities and Service agencies (water supply, gas, electricity supply and telecommunications) with regards to Earthquake Risk Management is to ensure quick restoration of services and facilities and extent assistance in evacuation, Search & Rescue operations, transportation of relief & welfare items as well to help in Medical First Response to all levels of victims of earthquake disaster. Agreed actions listed in the National level Plan during normal times should be covered comprehensively during Agency level planning by the concerned utilities and service agencies. The level of preparedness at any given time determines the level of response capacity of the utilities and service agencies during any Earthquake disaster situation. The maintenance of standards of services and redness during normal times can be demonstrated through verification of effectiveness through simulations and conduct of regular stock taking and regular reporting. This ensures the response capacity of the utilities and service agencies to any disaster situation.
- For effective preparedness, the utilities and service agencies must have a clearly defined Earthquake Contingency Plan, in order to avoid confusion and, improve efficiency in cost and time
- Operating procedures for mobilizing staff, manpower, and material during various stages of earthquake emergency response should be identified by the respective agencies in the Agency level Earthquake Contingency Plan. All utilities and service agencies are required to study the National Earthquake Contingency Plan and adopt appropriate measures to ensure the uninterrupted services by respective agency during post earthquake period.
- Also the agencies should ensure the utilities and service agencies have taken maximum effort to control the occurrence or outbreak and any kind of spread of collateral hazard events such as fire outbreaks
- Orientation and training for implementation of the Earthquake Contingency Plan and procedures accompanied by simulated exercises will keep the utilities and service agencies prepared for meeting the needs to act in Earthquake events. Special skills required during earthquake emergency response operations need to be imparted to the officials and the staff of utilities and service agencies. Selected personnel can be deputed for training’
- A designated officer from each organization listed under utilities and service agencies at national level should take the role of as "NODAL OFFICER –Gas Transmission”. In the similar way the officers should be designated as "Officer-in-charge – Gas Transmission” at the city level to take charge of Earthquake Contingency Plan related functions.
- Measures should be undertaken to enhance the capacity of utilities and service agencies regularly in terms of man-power, equipment, material etc to respond to an Earthquake disaster.

6.2 Normal time activities

- Assess preparedness level and report the same as per the reporting formats to National Emergency Operation Centre (EOC) every six months
- Conduct training and capacity building programs to provide necessary skills and knowledge on handling utilities and service agencies issues during Earthquake emergency
- Obtain maps of all supply routes, operational areas of utilities and services by respective agencies and store them carefully so that it can be made available to authorities with short notice after Earthquake emergency. Keep and maintain Earthquake Contingency plans with spatial databases so that in case of severe damage to utilities and services a quick assessment could be undertaken by the respective authorities to establish most essential services within the shortest time period.
- Maintain a list of Earthquake Disaster prone areas in the city level and conduct simulations to verify the preparedness level to respond to earthquake events (especially involve the Emergency repair and maintenance teams in simulations)
- Appoint and designate the Emergency Repair teams and develop database of such officers with contact numbers. Develop a coordination mechanism between utilities and service agencies and response agencies. Develop and maintain database of heavy machinery (specify the number, location, etc) belong to the respective Institution that can be used during emergencies
- Conduct verification of stocks of spare parts and material necessary for restoration of utilities and services by respective agencies.
- Conduct vulnerability assessment of buildings and make arrangements to ensure critical facilities and buildings will be under safe conditions during Earthquake emergencies.

6.3 Activities on receipt of notice of Activation if National Earthquake Contingency Plan

- All personnel from Utilities & lifelines services required for Earthquake Emergency response should work under the overall supervision and guidance of Response Commander of the respective area. Within the affected area all available personnel from Utilities & lifelines services will be made available to the Response Commander of the respective area. If more personnel are required, then out of station or those on leave may be recalled.
- Establish radio communications between Utilities & lifelines services and Emergency operations centre and other relevant officials to provide necessary assistance by establishing uninterrupted services to affected areas. The switching off of supply to designated areas should be taken care of in order to avoid fire out breaks.
- All relevant department vehicles should be fueled and parked in the protected arrears so that they can be used for emergency response duties.

- Maintenance and repairmen should be instructed to assemble and check repair equipment and ready to be dispatched to affected areas for restoration of Utilities & lifelines services. Plans should be developed for sending auxiliary staff and repairmen into the affected areas to assist local staff in restoration of Utilities & lifelines services when required. Every work gang should have tools which will be needed in an emergency.
- The special service personal with responsibilities for cut of services, switching off supply lines etc should be given special training and they should liaise with relevant officials from Fire service and civil Defence and other emergency response agencies in case of fire outbreak in order to bring the events under control without spreading it to other areas.
- Contingency plans should be established for providing food and emergency shelter for local staff, and for auxiliary staff being sent into the affected area for restoration of supply lines, repairs, switching off the supply lines etc.
- Arrangements have to be made to assist the increased volume of traffic for telecommunication services. If necessary dedicated lines should be assigned and operated for the use by emergency response personal from first responder agencies. Mobile phone operators have restrictions to reduce the inflow of calls and to serve the emergency service personal.
- A rapid assessment of the number and location of landslides, damage power connections, water lines, telephone connections, gas supply lines, areas affected by liquefaction, subsidence and places covered with debris should be carried out, to ensure at least a minimum level of utilities and services during an emergency situation. Public announcements should be provided through media at regular intervals to inform the public about the disruption of services. Personal involved in operation of underground water supply schemes, power supply schemes etc should be given strict advises for avoiding flooding of equipment.
- Emergency instructions for services and utilities should be developed. All staff should be well trained to implement the emergency supply systems of utilities and life line services.
- Within the emergency operating framework, emergency procedures should be developed to provide the utilities and life line services with authority, to dispatch or Holt services and take other emergency decisions in a disaster threatening situation to provide temporary services to hospitals, schools and evacuation centers, police, AFD, FS&CD etc. If halting or termination of utilities and services is intended for certain areas, arrangements for alternate means of supply to critical facilities, VIPs etc must be ensured.
- Polythene or other material should be acquired for the protection of very essential valuable equipments such as transformers, controlling stations, pumps, storage tanks etc. All perishable and breakable items should be loaded in to lorries, transported, stored and padlocked in safer areas

- Reserve stocks of fuel should be checked. Additional stand by generators, pumping stations etc should be transported and placed to ensure supply to critical facilities such as hospitals, cams for displaced, police etc. Where necessary attempts should be made to pre-positioned generators, water supply wells, tanks, transportation vehicles, etc.
- Inspection of all supply lines, by appropriate specialists and engineers shall be carried out to ascertain the damage levels. A full check on all concrete and steelworks should be included, and any repairs needed should be promptly carried out.
- Emergency repairs of service lines and utilities if affected, must be carried out

Readiness Checklist

7.1 Readiness Checklist and Reporting Formats

Preparedness Check List for TGTDCL

Preparedness measures taken	Details/Remarks
All staff of TGTDCL are familiar with this plan as well as city level contingency plan	
Orientation and training for implementation of Earthquake Contingency plan and procedures undertaken at different level	
Special skills required during emergency operations imparted to the designated officials and the staff	
Prepositioning of the emergency gas at different evacuation spaces is carried out	
Equipment and cost require for early recovery of gas system are planned	
Compressor stations are assessed in detail and the facilities are retrofitted accordingly	
Reviewed and updated - Precautionary measures and procedures for coordination between different utility and lifeline service agencies during earthquake emergencies - A list of special emergency restoration teams, the data base on heavy equipment, spare parts needed for quick restoration of utilities and lifeline services under relevant agency - Training and capacity building programs, Plans to conduct routine simulations - the precautions to be taken to avoid fire out breaks, floods inside buildings etc - the precautions to be taken to protect equipment during earthquake emergencies - procedure for assessment of damages to buildings and granting permission to use them after inspection - The post-disaster procedures to be followed.	

Reported By: Designation:
Signature: Date

Agency Level Actions for Training & Capacity Building of Staff, Awareness Creation, Reporting, Pre-positioning of Emergency Facilities, Resource Mobilization for Purchase of Equipments

8.1 Assessment of Existing Capacity (Man power, equipment and material)

Titas Gas T & D Co. Ltd. (TGTDCL) was formed in November 1964 as a joint Stock Company (Under the Company's Act 1913) of the central Government of Pakistan on the one hand and Pakistan Shell Oil Company on the other, with a view to transmitting and distributing natural gas to the Dhaka city the then provincial capital of Pakistan from the discovered gas field called "Titas" located on the bank of the River Titas, within the close vicinity of the present Brahmanbaria district of Bangladesh. The authorized capital was Taka 17.8 million only, divided into 17800 shares of Taka 10.00 each.

The basic objective of the Company was to construct, own and operate natural gas transmission & distribution facilities in the mid-eastern region of Bangladesh i.e. Comilla, Mymensingh and Dhaka district with the right of purchasing, transmission, distribution, sales and disposal of natural gas within the jurisdiction of greater districts before creation of new districts.

TGTDCL has, by its own right and merit, earned the reputation as well the capacity to undertake any major project in Gas Engineering, Pipeline Construction, Operation and Maintenance thereof and also in the marketing of gas in the country.

8.2 Gap Analysis (Man power, equipment and material)

Followings are the key elements identified to enhance the emergency preparedness for a sustainable response.

Type of gap	Description	Remarks
General	• Difficulties for compliance to the Standard Operation Procedure (SOP) of TGTDCL since Earthquake aspect is not covered adequately. • There is no job description for all levels of Disaster Management Personnel inside the TGTDCL.	• Needs specific job descriptions are needed to incorporate into the SOP. • Need to prepare earthquake & tsunami response plan separately.
Training & Capacity Building	• Limited training programs are conducted by the TGTDCL	• Training Institute needs to be established w TGTDCL.
Coordination among stakeholders	• There have minimum coordination all stakeholders (DMB, CDMP, LGRD/Civil Admin./Fire Service & Civil Defence/ Army/NGOs/CBOs and other relevant ministries) • No regular coordination at all level	• An effective internal & external Coordination Mechanism needs to be developed.

	with GO, NGO Donors for Disaster Management	
Public awareness	• There are very few training activities on capacity building and regular Mock drill for preparedness for any impending disasters and post-disaster Water Supply & Sewage management.	• Needs to conduct trainings & Mock drills regularly for emergency disaster preparedness.
Equipments	• There are scarcity of medical equipments such as transports, medicine, mobile hospitals, emergency medicines, trained manpower etc.	• Needs assessment has to be conducted based on the possible worst-case scenarios and then required resources has to be mobilized.

8.3 Process for addressing the gaps

Enhanced capability of the Gas Transmission sector to effectively address the risks to emergencies through:

- Development of an integrated emergency Gas Transmission management mechanism that covers areas of risk assessment, capacity building, public awareness as well as effective emergency response capability;
- Using "Gas Transmission Network Mapping" as a useful operational tool for the risk assessment of the hazard prone areas;
- Development of technical guidelines, and surveillance standards in order to promote best Gas Transmission practice during humanitarian crisis situation;
- Capacity building for rapid needs assessment following any emergency in order to ensure that the most vulnerable population benefit from the humanitarian relief Programme.

8.4 Action Plan for Enhancement of Capacity

- Establishment of core group at periphery level including all stakeholders (DMB, CDMP, LGRD/Civil Admin./Fire Service & Civil Defence/Army/NGOs/CBOs and other relevant ministries)
- Enhanced the national capacity of disaster mitigation in respect of planning and responding to disasters, like Earthquakes and Tsunamis by preparing Earthquake/Tsunami Response Plan
- Conduct and assess field based survey to find out vulnerability of the area for their capacity building by table-talk & simulation exercise.
- Provide more training – capacity building and regular Mock drill for preparedness for any impending disasters and post-disaster Gas Transmission management.
- Strengthening epidemiological surveillance as well as increase laboratory capacity.
- Ensuring adequate supply of logistics like life-jacket, rain-coat, umbrella, gum boot, and others essential materials during response activities.

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Glossary of Terms

Building Codes — Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards.

Capacity — A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

Capacity Building — Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.

In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Cluster — A "cluster" is essentially a "sectoral group" and there should be no differentiation between the two in terms of their objectives and activities; the aim of filling gaps and ensuring adequate preparedness and response should be the same. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Cluster Approach — The Cluster Approach aims to strengthen humanitarian response capacity and effectiveness in five key ways: i) ensuring sufficient global capacity is built up and maintained in key gap sectors/areas of response; ii) identifying predictable leadership in the gap sectors/areas of response; iii) facilitating partnerships and improved inter-agency complementarity by maximizing resources; iv) strengthening accountability; and 5) improving strategic field-level coordination and prioritization in specific sectors/areas of response by placing responsibility for leadership and coordination of these issues with the competent operational agency. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Cluster Leads — A "cluster lead" is an agency/organization that formally commits to take on a leadership role within the international humanitarian community in a particular sector/area of activity, to ensure adequate response and high standards of predictability, accountability & partnership. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Disaster — A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient

	capacity or measures to reduce the potential negative consequences of risk.
Disaster Risk Management	The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.
Disaster Risk Reduction (disaster reduction)	The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development. *The disaster risk reduction framework is composed of the following fields of action, as described in ISDR's publication 2002 "Living with Risk: a global review of disaster reduction initiatives", page 23:* • *Risk awareness and assessment including hazard analysis and vulnerability/capacity analysis;* • *Knowledge development including education, training, research and information;* • *Public commitment and institutional frameworks, including organisational, policy, legislation and community action;* • *Application of measures including environmental management, land-use and urban planning, protection of critical facilities, application of science and technology, partnership and networking, and financial instruments;* • *Early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.*
Earthquake	An earthquake is a series of vibrations on the earth's surface caused by the generation of elastic (seismic) waves due to sudden rupture within the earth during release of accumulated strain energy.
Emergency Management	The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation. *Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.*
Emergency	Consists of all activities taken in anticipation of a crisis to expedite effective emergency response. This includes contingency planning,

Preparedness	but is not limited to it: it also covers stockpiling, the creation and management of standby capacities and training staff and partners in emergency response. (Source: ODIHPN Contingency Planning Review Paper 2007)
First Responder	The term 'first responder' refers to those agencies/ individuals who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment, including emergency response providers as well as emergency management, public health, clinical care, public works, and other skilled support personnel (such as equipment operators) that provide immediate support services during prevention, response, and recovery operations. *Source: Homeland Security Act of 2002 (6 U.S.C. 101, Washington, U.S.A.)*
Geographic information systems (GIS)	Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced. *Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.*
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.*
Hazard Analysis	Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour.
Land-use Planning	Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions. *Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.* *Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key*

	installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.
Natural Hazards	Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. *Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.*
Planning Assumptions	The key elements of a scenario that form the basis for developing a contingency plan (for example, projected caseloads) (Source: IASC Contingency Planning Guidelines 2001)
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.
Prevention	Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters. *Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".*
Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. *Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.*
Relief / Response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.
Resilience / Resilient	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Retrofitting (or upgrading)	Reinforcement of structures to become more resistant and resilient to the forces of natural hazards. *Retrofitting involves consideration of changes in the mass, stiffness, damping, load path and ductility of materials, as well as radical changes such as the introduction of energy absorbing dampers and base isolation systems. Examples of retrofitting includes the consideration of wind loading to strengthen and minimize the wind force, or in earthquake prone areas, the strengthening of structures.*
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. *Conventionally risk is expressed by the notation Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.* *Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes. (Source: ISDR)*
Risk Assessment/Analysis	A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend. *The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability; and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios.*
Scenario	An account or synopsis of a possible course of events that could occur, which forms the basis for planning assumptions (for example, a river floods, covering a nearby town and wiping out the local population's crop) (Source: IASC Contingency Planning Guidelines 2001)
Scenario-building	The process of developing hypothetical scenarios in the context of a contingency planning exercise. (Source: IASC Contingency Planning Guidelines 2001)
Seismic Hazard	Seismic hazard in the context of engineering design is defined as the predicted level of ground acceleration which would be exceeded with 10% probability at the site under construction due to occurrence of earthquake anywhere in the region, in the next 50 years.
Sustainable	Development that meets the needs of the present without

development compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs. (Brundtland Commission, 1987).

Sustainable development is based on socio-cultural development, political stability and decorum, economic growth and ecosystem protection, which all relate to disaster risk reduction.

Vulnerability The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

For positive factors, which increase the ability of people to cope with hazards, see definition of capacity.