

Development of Earthquake Emergency Response Plan for Tribhuvan International Airport, Kathmandu, Nepal

Research Project Report



USACE Engineer Research and Development Center

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Executive Summary

The U.S. Army Corps of Engineers' (USACE) awarded in April 2012 a research and development project to The University of British Columbia (UBC) to develop a methodology for the Earthquake Emergency Response Plan of the Tribhuvan International Airport in Kathmandu, Nepal. A team of professionals from UBC, the Federal Aviation Administration (FAA) and the U.S. Army Corps of Engineers' (USACE) worked together to implement the project plan.

The team project developed a disaster response plan (DRP) for TIA that focuses on earthquake hazard. The project team also delivered a responsibility synchronization matrix and TIADRP action checklists for two key positions: the Director of Civil Aviation Authority of Nepal (CAAN) and the General Manager of TIA Civil Aviation Office (CAO). Appendices to this report include resource documents containing guidelines for post-earthquake assessment of airfield for damage and throughput capacity, damage assessment of airport structures, utilities and operational/functional components (OFCs) and a list of rapid repair kit items. A list of recommendations for risk mitigation and effective recovery of the airport were also included based on need.

The development of the plan built upon previous work already performed by CAAN, TIA and others. In developing the response plan the project team used stakeholders' input as the primary basis. Secondary data was also used wherever available and was taken mostly from published reports and documents. For developing the resource documents, the procedures for post-earthquake rapid damage assessment of airport buildings, utilities and other OFC, and procedures for rapid repair of airfield pavement, guidelines and other literature from the United States, Canada, and Japan etc. were adapted for Nepalese context.

The critical steps used in developing the plan included the collection and review of pertinent data and information, interaction with professional and key persons of the concerned authorities, development of emergency response action items, rapid assessment and recovery strategy for the airport and the development of a strategy for emergency aid handling.

The Project team visited Kathmandu in July 2012 for two weeks and in September 2012 for a week to participate in a workshop about the project. The visits were mainly to collect data, meet with stakeholders and conduct field inspections. The team worked with the Nepalese government agencies to conduct interviews, collect data, review documents, analyze disaster scenarios, and factor multiple risks, requirements and considerations into the development of a draft all-hazard airfield emergency response plan for TIA, Kathmandu, Nepal. The United Nations (UN) and other international agencies, as well as, private airlines were consulted during the visits. The team developed the first draft of the earthquake emergency response plan in September 2012 and then made a second visit to Kathmandu to get the stakeholders' feedback and finalize the document. In a week-long visit, the team met the staff of TIACAO and CAAN and presented the draft document for a point-wise discussion where comments, concerns and

input from TIACAO and CAAN staff were received. In the meantime, other stakeholders also provided their feedback on the draft plan. The team finalized the document incorporating the input and delivered the document to CAAN on 23 September 2012 during the project delivery meeting and workshop in Kathmandu.

The deliverables of the project included:

- **Airport Earthquake Emergency Response Plan for TIA:** a self-standing airport earthquake emergency plan has been developed. The plan considers two phases: emergency response of the airport covering activities before, during and immediately after the earthquake; and airport operation for emergency aid supply in the aftermath of the earthquake for smooth transit and distribution of emergency personnel and relief material to the affected areas.
- **Guidelines for post-earthquake assessment of the airport system:** the methodology included in the guidelines provides a step-by-step procedure for conducting post-earthquake assessment of airport facilities and criteria for tagging them (Green, yellow and Red). This is based on rapid visual inspection techniques.
- **Rapid repair kit for airport runway:** this includes a list of items and their storage in non-emergency time and usage in the aftermath in case the runway gets damaged during a major earthquake. A sample of quick repair to airfield pavement is also illustrated.

The basic premise for an emergency response plan to be effective for the TIADRP is that it should be implementable to the specific setting of Kathmandu. The project team made an effort to make the plan compatible with the specific circumstances including hazard, institutional framework, available resources and technology, and need for improvement. Another important aspect is accommodating the stakeholders' perceived concerns.

The focus of the team's effort was not only the delivery of the plan but the process of its development. The guiding principles of the project are that the plan should be applicable to TIA conditions; it should be simple and clear in imperative format and; provisions should be based on evidence and need to be tested in the field. The ownership of the plan should rest with the stakeholders.

In the execution of the project, we learned valuable lessons that were the results of observations, agency interaction and project activity outcomes. The context and unique characteristics of the project site also offered new insights to the problem. Important observations and major lessons learned from the project include:

- i. Vulnerability assessment and geotechnical investigation prompted stakeholders to create an Emergency Response Plan.
- ii. The Logistics plan for humanitarian assistance needs to be an integral part of the ERP

- iii. Improvements to the current state of preparedness are necessary to provide the base level for the Emergency Response Plan.
- iv. The ERP is a dynamic document and needs periodic updates.
- v. Stakeholders' buy-in is possible through their engagement in the process and ensuring that their concerns take precedence.
- vi. The initiative had an impact beyond its original scope.

To ensure the document will remain dynamic and up-to-date, improvements and other modifications can be easily incorporated as needed in the future. The response plan will need periodic revisions based on the changing role of organizations, their resources and other vulnerability factors associated with the seismic hazard in the country.

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ACRONYMS

Development of Earthquake Emergency Response Plan of Tribhuvan International Airport Kathmandu, Nepal

1.	AEP	Airport Emergency Plan
2.	AFP	Armed Police Force
3.	AOA	Aircraft Operators Association
4.	CAAN	Civil Aviation Authority of Nepal
5.	CDRC	Central Disaster Relief Committee
6.	CMCC	Civil-Military Coordination Center
7.	CSSR	Collapsed Structure Search and Rescue
8.	DRR	Disaster Risk Reduction
9.	ECC	Emergency Control Center
10.	FAA	Federal Aviation Administration US
11.	FHWA	Federal Highway Administration US
12.	HSA	Human Staging Area
13.	HSU	Humanitarian Support Unit
14.	IASC	UN Inter-Agency Standing Committee
15.	ICRC	International Committee of the Red Cross
16.	IDP	Internally Displaced Persons
17.	JICA	Japan International Cooperation Agency
18.	KMCTH	Kathmandu Medical College Teaching Hospital
19.	MOG	Maximum On-Ground
20.	MoHA	Ministry of Home Affairs
21.	MOTCA	Ministry of Tourism and Civil Aviation
22.	NA	Nepal Army
23.	NAVAID	Navigational Aid
24.	NDRF	National Disaster Response Framework
25.	NEOC	National Emergency Operations Center
26.	NGO	Non Government Organizations
27.	NI	Nepal Immigrations
28.	NID	Nepal Investigations Department
29.	NIH	Norvic International Hospital
30.	NOTAM	Notice to Airman
31.	NP	Nepal Police
32.	NRRC	Nepal Risk Reduction Consortium Secretariat
33.	NSET	National Society for Earthquake Technology - Nepal
34.	OSOCC	On-Site Operations Coordination Center
35.	PPCR	Pilot Program for Climate Resilience
36.	RVA	Rapid Visual Assessment
37.	SME	Subject Matter Experts
38.	SOP	Standard Operating Procedure
39.	TIACAO	Tribhuvan International Airport Civil Aviation Office
40.	TIADRP	Tribhuvan International Airport Disaster Response Plan
41.	UBC	The University of British Columbia
42.	UN	United Nations
43.	UN HC	Humanitarian Coordinator UN
44.	UN OCHA	Office for the Coordination of Humanitarian Affairs
45.	USACE	United States Army Corps of Engineers
46.	USAID	United States Agency for International Development
47.	USPACOM	US Pacific Command
48.	USR	Urban Search and Rescue
49.	WFP	World Food Program UN

1. Introduction

The purpose of this research project is to develop and implement a methodology that can be used for creating emergency response procedures in the event of a significant earthquake affecting the normal operations of airports in developing countries. Major airports in developed countries generally have well-defined emergency response plans that include specific procedures for responding to earthquakes and other natural events. Because of the complexity of operating major airports, such procedures are very detailed and require detailed lists of actions to be carried out and that should be done in adherence to existing rules and regulations. This results many times in documents describing the response plan that include hundreds of pages and that require extensive training of airport personal over an extended periods of time, and that are not applicable to smaller airports or airports in developing countries. For such cases it is impractical to create highly detailed emergency response plans since it is very likely that the facility would lack the necessary staff or resources for a successful implementation of such plan.

There is clear need to develop emergency response plans that are simpler to implement and are more suitable to the capabilities of small airports or airports in developing countries. And this should be done as a cooperative effort between experts in operations and management of airports and subject matter experts that will work closely with the various stakeholders and organizations involved in the daily operations of these types of airports.

The development of the methodology to create simple and effective earthquake response plans will be done by reference to a case study in a developing country. The airport of the city of Katmandu in Nepal has been selected as the case study.

The outcomes of the project are:

1. Development of an all-hazards aviation response plan;
2. A document that centralizes aviation requirements for emergency response and recovery;
3. Identification of critical land-use requirements for emergency response/recovery;
4. A response document that can tie into an existing National Response Plan; and
5. Ensure the final plan maximizes airfield operations, space, and equipment.

The critical needs in regards to the continued operation of the airport for smooth supply of emergency aids and relief operation missions are:

1. Seismic vulnerability assessment of the airport system
2. Specific post-earthquake assessment template for the airport to be used in the immediate aftermath of the earthquake
3. Provision of rapid repair kit for the runway
4. Earthquake emergency response plan for the airport. This should include roles and responsibilities of agencies, command and control system, communication plan, resource/logistic plan, checklists and standard operating procedures (SOP).

The U.S. Army Corps of Engineers' (USACE) commissioned The University of British Columbia (UBC) to develop a methodology for the implementation of an Earthquake Emergency Response Plan (EERP) of Tribhuvan International Airport (TIA), Kathmandu, Nepal. A team of professionals from UBC, Federal Aviation Administration (FAA) and the U.S. Army Corps of Engineers' made a visit to Kathmandu for two weeks in July 2012 and collected data from stakeholder agencies and individuals. A series of meetings, interviews, field visits and a workshop were conducted during the visit to collect information and get stakeholders' input and viewpoints on the proposed EERP for TIA. The team developed the first draft of the EERP in September 2012 and made their second visit to Kathmandu to get the stakeholders' feedback and finalize the document. In a week-long visit, the team met with TIACAO and CAAN staff to present the draft document for a point-wise discussion where comments, concerns and input were received. In the meantime, other stakeholders also provided their feedback on the draft plan. The team finalized the document incorporating the input and delivered the document to CAAN on 23 September 2012 in a project delivery meeting in Kathmandu.

This report contains brief accounts of meetings with stakeholders and field visits, approach and methodology followed in the development of the EERP document, brief features of the plan document, lessons learned and future works.

1.1. Background

Nepal is one of the most earthquake prone countries in the world. A detailed review of the existing earthquake catalogue for the region indicates that devastating earthquakes are inevitable in the long term and a major earthquake is likely to occur in the near future. In the past, big earthquakes in Nepal (see Figure 1.1) have caused a huge number of casualties and damage to structures. The Great Nepal-Bihar earthquake in 1934 reportedly killed 8,519 persons and damaged 80,000 buildings just within Nepal's borders. The earthquake destroyed 20 percent, and damaged 40 percent, of Kathmandu's building stock. However, a large earthquake today near Kathmandu, which is the cultural, political and economic heart of the country, would cause a far greater human tragedy, extensive physical damage, cultural loss and economic crisis than was caused by past earthquakes. With the city's burgeoning population, uncontrolled development, and a construction practice that has actually degraded over the last decades, it is becoming increasingly vulnerable to earthquakes with each passing year. The seismic hazard map for a 500 year return period event shown in Figure 1.2 indicates that most of the country is located in zones of high to very high ground shaking. This high seismic hazard, combined with the high vulnerability of the infrastructure of the country, results in high seismic risk for most of the country.

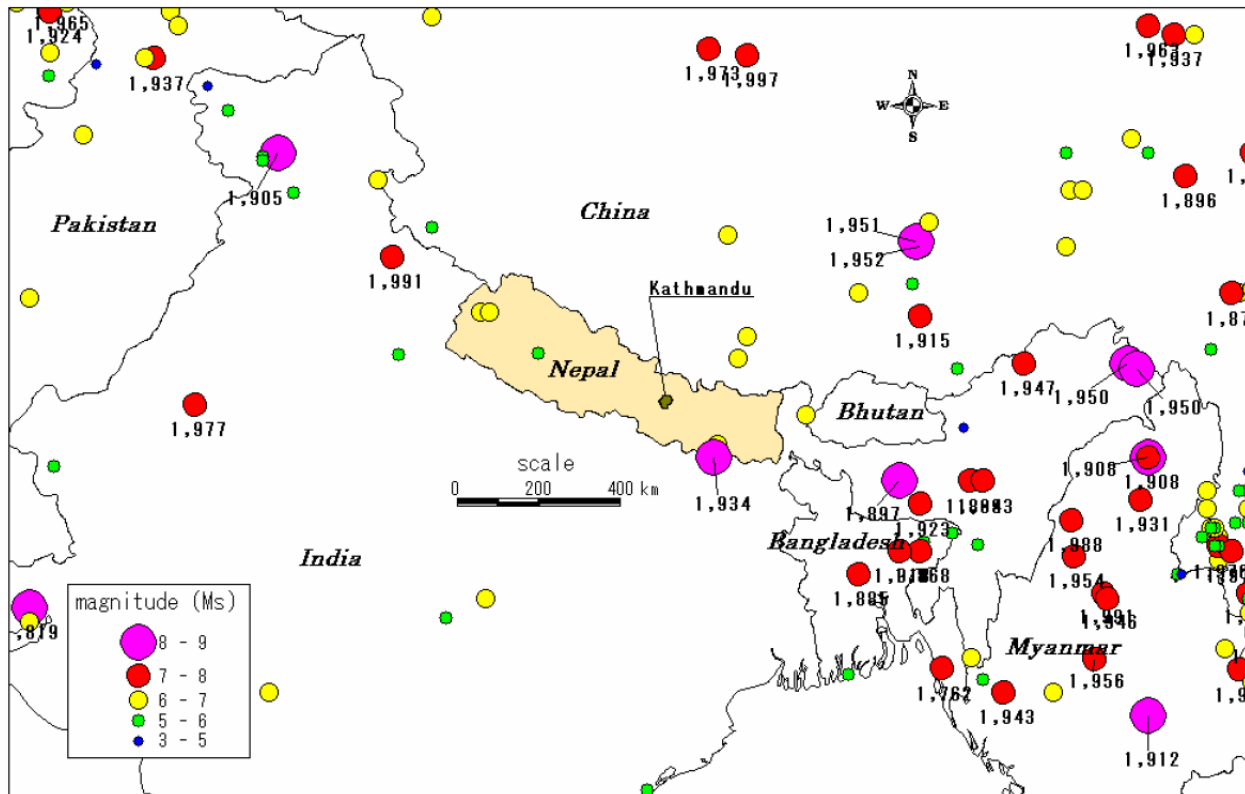


Figure 1.1 Historical Earthquakes in The Himalayas (after Utsu, 1990)

Lessons from recent earthquakes in developing countries, particularly those ill prepared to absorb the shock, suggest that an earthquake of large scale near Kathmandu today could cause similar death and devastation of a degree that has been observed in Kashmir, Pakistan and most recently in Port-au-Prince, Haiti. The consequences for Nepal if a comparable or bigger disaster happens in Kathmandu would likely be worse than in Port-au-Prince because the Kathmandu Valley is landlocked within a rugged mountainous valley and the city's ability to connect with the outside is limited to ground transportation (susceptible to be dysfunctional in major earthquakes) and air transportation.

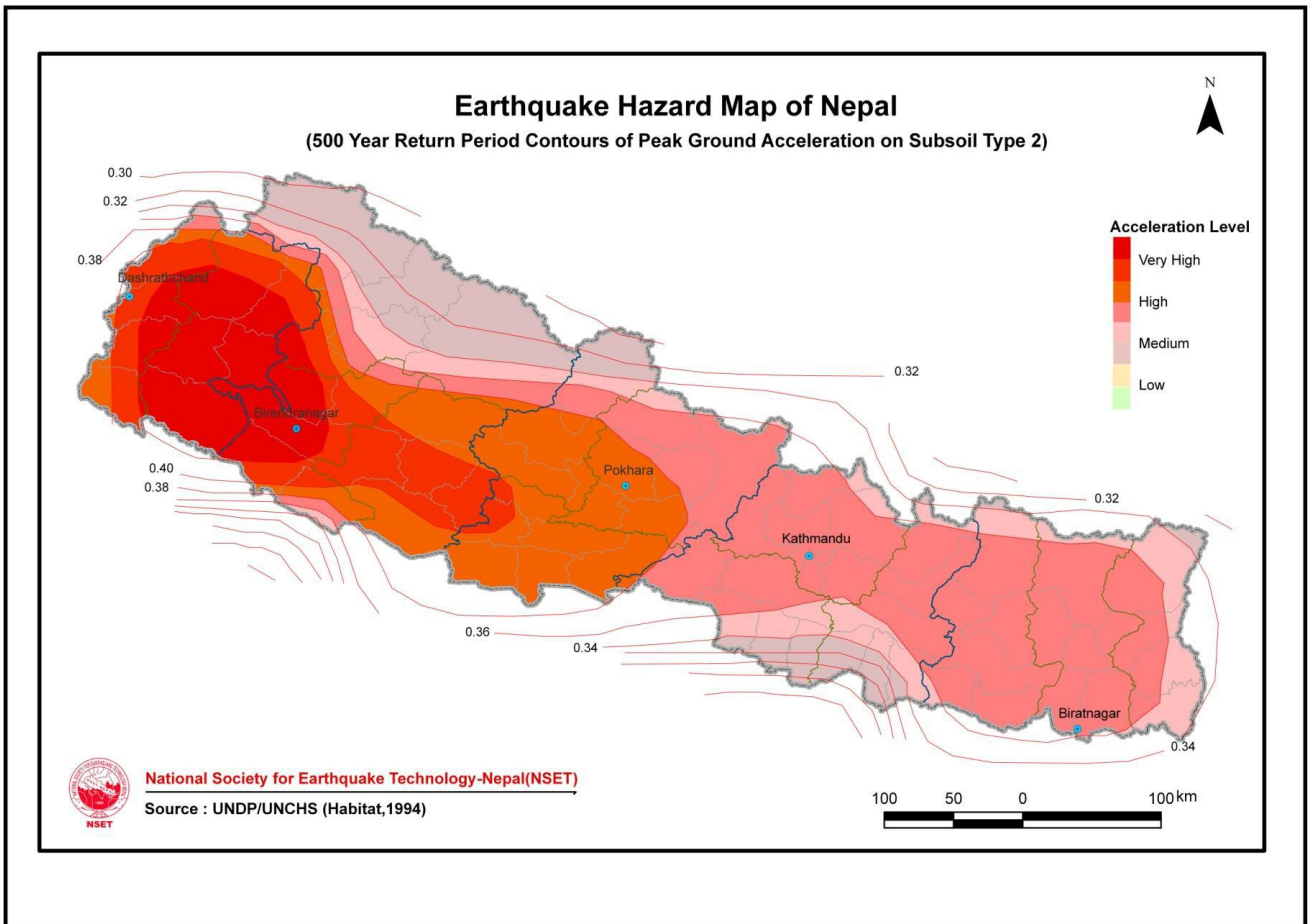


Figure 1.2 Earthquake Hazard Map for Nepal

Tribhuvan International Airport is expected to be the only means of transportation for international aid and relief operations after a catastrophic earthquake hits the country. Without an emergency response plan in place, TIA is not designed to meet the operational demands required to properly respond to a catastrophic event, which requires expeditious handling of response and recovery missions.

For continued operation of the airport with smooth supply of emergency aid and relief operation in the aftermath of a significant earthquake that affects the airport, it needs:

- EERP for the airport including roles and responsibilities of agencies, command and control system, communication plan, resource/logistic plan, checklists and standard operating procedures (SOP).
- Specific post-earthquake assessment template for the airport to be used immediately after the event
- Provision of rapid repair kit for the runway.

This project addresses these needs. The project developed a disaster response plan of TIA that focuses on earthquake hazard. The annexes of the plan contain several resource documents including post-earthquake assessment of airfield for damage and throughput capacity, damage assessment of airport structures, utilities and OFCs and lists of rapid repair kit items. A list of recommendations for risk mitigation and effective recovery of the airport as envisioned in the plan are also made based on the need observed by the team of professionals who developed the plan.

1.2. Goal and Objectives

The goal of this project was to support CAAN and TIA to better prepare the country's only international airport to plan for, respond to, and recover from a large-scale emergency situation.

Towards meeting the goal, the project developed a disaster response plan for Tribhuvan International Airport in case of an earthquake, which can be applied to all hazards. In order to achieve this, following objectives were set for the project:

- i. Centralize aviation requirements for emergency response and recovery into one document;
- ii. Identify critical land-use requirements at TIA for emergency response/recovery;
- iii. Analyze subsurface and geotechnical data to derive a hazard plan that includes a liquefaction potential map;
- iv. Prepare a response document that can tie into Nepal's National Disaster Response Framework;
- v. Ensure the final plan maximizes airfield operations, space, and equipment to support disaster relief operations; and
- vi. Encourage interaction and communication of all stakeholders.

1.3. Scope, Limitation and Future Developments

The DRP developed under this project has a primary focus on earthquake hazards. Its application to other hazards can be cross-referenced, but may not match specific requirements and/or needs in all circumstances. The plan document is bound to underlying assumptions and disaster scenarios as discussed in later sections.

During the preparation of the plan, the team met with as many stakeholders as possible. In some instances, the team was not able to meet with every aviation stakeholder, and their contributions to this plan may still be required. The TIADRP, as such, is a living document and requires continuous updates to be relevant and beneficial.



2. Project Specifics

2.1. Project Team

The following individuals and organizations were involved in the development of the plan and associated resource documents prepared under this project.

University of British Columbia, Canada

1. Dr. Carlos Ventura, Principal Investigator and Seismic Advisor
2. Mr. Bishnu Pandey, Project Engineer & Coordinator
3. Dr. W.D. Liam Finn, Geotechnical Advisor
4. Dr. Jason Dowling, Research Engineer

Federal Aviation Administration, USA

5. Mr. Pablo Riofrio, Technical Director

U.S. Army Corps of Engineers

6. Mr. Sean Dowling, Emergency Planning Advisor
7. Mr. Justin Pummell, Project Manager

Team members that visited Nepal during the course of this project are presented in Figure 2.1:



Figure 2.1 Project team members during the July 2012 visit to Kathmandu. From left to right: C. Ventura, B. Pandey, S. Dowling, Pablo Riofrio and J. Pummell

2.2. Schedule

Activities	June 2012		July				August				September 2012			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Literature review														
Review of results from geotechnical investigation and pavement testing														
Development of framework for earthquake emergency response plan														
Data collection, stakeholders' meeting, workshop, interviews, field visits (1 st visit to Kathmandu)														
Development of draft earthquake emergency response plan														
Point-wise discussion on draft plan with CAAN, TIACAO and stakeholders' meeting (2 nd visit to Kathmandu)														
Delivery of the plan and resource documents														

2.3. Project Deliverables

As the outcome of the project, the project team delivered the following documents to CAAN and TIACAO:

1. TIADRP and Appendices including
 - Airport Earthquake Emergency Land Use Map;
 - Air Traffic Throughput Calculation Procedure;
 - Examples of Earthquake Damage of Airfield;

- Rapid Visual Assessment of Masonry and Concrete Building Components;
 - Example of Rapid Repair of Airfield Pavement, etc.
2. Recommendations for risk mitigation of TIA and effective application of TIADRP
 3. Responsibility synchronization matrix
 4. TIADRP action checklists for key positions: Director of CAAN and General Manager of TIACAO

3. Methodology

3.1. Approach

The development of the plan built upon previous work already performed by CAAN, TIA and others. The plan incorporated information, results, and recommendations from Subject Matter Experts (SME) from the Federal Highway Administration (FHWA), FAA, U.S. Office of Defense Cooperation (Kathmandu), USAID and USACE, who visited Kathmandu in 2011 to make a seismic assessment of TIA. The results of geotechnical investigation and airport pavement analysis carried out by USACE that identified the vulnerable spots in terms of potential liquefaction, slope stability failure and pavement failure were considered in the development of the plan and recommendations.

In the development of the response plan the project team used stakeholders' input as their primary basis. Their input was in the form of information sheets, organizations' strategies and programs, representatives' viewpoints etc. The input from stakeholders was received both written and orally in interviews and meetings (see Figure 3.1). Relevant laws, government rules and regulations, by-laws, and existing TIA SOPs were studied and taken into account.



Figure 3.1 Example of meetings with stakeholders

TIACAO staff provided a list of their resources, SOPs, and presented their input and concerns in the earthquake emergency response plan. Airlines and aircraft operators also provided their input in the development of the plan. Security agencies including the Nepal Army (NA), Armed Police Force (AFP), Nepal Police (NP), and Nepal Immigration Department (NID) were consulted for their potential role in an emergency situation. Other government, semi- government agencies and private organizations including the Ministry of Home Affairs (MoHA), Department of Customs, NID, Nepal Oil Corporation (NOC), and Kathmandu Medical College Teaching Hospital (KMCTH) provided their input as well. The constraints and limitation of resources of these

organizations in relation to an effective operation of the airport in an emergency are considered in the development of the plan. The international organizations including UN bodies, European commissions, International Committee of Red Cross (ICRC) were consulted for their input, concerns and feedback. They provided excellent information on the current stock of disaster preparedness in the country from an international perspective. Their input is also crucial in developing the plan for logistical aid in the airport in the aftermath of the large disaster.

Secondary data was also used wherever available and was taken mostly from published reports and documents. The information from reports of UN organizations, Japan International Cooperation Agency (JICA), ICAO and FAA, etc. were considered reliable and used in developing the plan documents. Other major sources of secondary information were the SME's reports on the vulnerability of the TIA system, geotechnical investigation of TIA sites, and the Pavement analysis of TIA Airfield. Some field visits to the airfield were conducted for conformity and verification of the data presented.

For development of resource documents, in particular, procedures for post-earthquake rapid damage assessment of airport buildings, utilities and other OFCs and procedures for rapid repair of airfield pavement, guidelines and other literature from the United States, Canada, and Japan etc., are adapted for Nepalese context. TIA's physical structures, its equipment, and available resources are taken into consideration in developing the guidelines and templates for rapid assessment and repair.

One of the important aspects of the development of TIAs DRP plan is the engagement of stakeholders from the early stage of formulation to finalization of the plan. A constant interaction between the project team and staff of TIACAO and CAAN was ensured during the entire process of the plan development. The first draft of the plan was developed considering all the information received from stakeholders and each provision of the plan document was reviewed one-by-one by the TIACAO and CAAN staff before being finalized. This ensured not only that the entire plan document was up to date, relevant and non-conflicting but also that the plan development ownership belongs to the implementing agencies. Other stakeholders also provided their input both at the formulating and finalization phases. Their feedback for the final draft was also taken well into account.

To ensure the document will remain dynamic and improvements and other modifications are easily incorporated as needed in the future, the response plan will need constant revisions based on the changing organizations, their resources and other vulnerability factors.

3.2. Development of the Plan

The following activities are the critical steps in developing the plan document:

Collection and Review of Pertinent Data and Information

All available data, information and maps, including geotechnical reports and other assessment of airport facilities were collected and reviewed by the team. They were verified by field inspection and sample calculation as much as possible. The results of the vulnerability assessment of airport facilities, geotechnical investigations and pavement analysis were presented to the stakeholders in a workshop. This familiarized them with the current status of the TIA, which also helped them to develop input for the proposed disaster response plan based on the facts of vulnerability and capacity.

Interaction with Professional and Key Persons of the Concerned Authorities

Aviation specialists and earthquake engineers in the project team interacted with key persons of the Humanitarian Assistance/Disaster Relief (HA/DR) and Aerodrome community to collect information and expert opinion of the local context in emergency response and relief operation. The project team received local knowledge of aviation conditions and airport facilities from the technical staff of TIACAO and CAAN. Staff from various UN organizations provided their expert opinion of the vulnerabilities and disaster preparedness situation in the country.

A series of meetings were held with key persons of concerned agencies to receive their input for the plan. The project team gathered organizations' strategies, programs and resources that would influence flight operations at TIA in disaster emergencies. These meetings were held in July 2012 for two weeks. A workshop was also held where multiple agencies interacted and presented their concerns in a common platform.

Development of Emergency Response Action Items

This is a key component of the project. A framework of the plan was devised considering the organizational structure of CAAN and TIACAO, the disaster scenario, organizational strength in terms of resources and institutional arrangement and standard emergency response procedures adopted in other countries. The framework was made compatible with ICAO standards and TIA's current existing emergency plan for other emergencies like bomb threats, aircraft accidents, etc. Roles, responsibilities and action items for TIA CAO and CAAN staff as well for other stakeholder agencies were developed for different stages of the emergency after an earthquake. The main contents of the plan document include command and control structure, communication structure and emergency procedures.

Areas needing improvements in institutional capacity, provision of system redundancy and operational improvement were discussed, documented and included in the list of recommendations.

Development of Rapid Assessment and Recovery Strategy for Airport

The project team worked out a strategy for rapid assessment and recovery of the airport system after a possible severe earthquake. International experience, standard engineering practice,

knowledge from the past earthquake and local context are the main factors considered in developing the strategy for rapid assessment facilities and repair of airfield. Field visits to airfield and airport facilities and interactions with technical staff of TIACAO were made to ensure that the assessment and rapid repair strategies correspond well with local context.

Development of Strategy for Emergency Aid Handling

Two workshops were held in Kathmandu in July 2012 and September 2012 (as shown in Figure 3.2) inviting stakeholders, donor agencies and diplomatic missions to get input for their contribution towards managing the aid supply in the airport. A sectoral approach was taken to manage the aid supply. A comprehensive strategy was formulated with roles and responsibilities in line with commitment from the agencies. Interactions with officers of Civil Aviation Authority of Nepal (CAAN), private aviation companies, international governmental organizations, military and other agencies were the major factor defining the strategy.



Figure 3.2 Participants during the workshop of September 2012

3.3. Roster of Field Activities

The Project team visited Kathmandu in July 2012 for two weeks and in September 2012 for one week. The visits were mainly to collect data, meet with stakeholders and make field inspections. The team mainly worked with the Nepalese government agencies to conduct interviews, collect data, review documents, analyze disaster scenarios, and factor multiple risks, requirements and considerations into the development of a draft all-hazard airfield emergency response plan for

TIA in Kathmandu, Nepal. They met with the UN and other international agencies as well as private airlines during the visits. Two workshops, one in July and another in September were also conducted during the visits. Following are the major team activities during the visit to Kathmandu:

9th July 2012

A workshop was held in the TIA CAO with about 50 participants from 19 different organizations including government, UN bodies, international organizations and airline operators. The project team traveled to the Airport to present the final results of geotechnical investigations, pavement condition and strength tests that were performed in January 2012. First, the team presented the outcome of pavement testing and implications of lack of pavement maintenance. Then, results of the geotechnical investigation were presented. Mapped liquefaction potential was illustrated against current airport facilities as well as 2028 master plan drawings. Results of slope stability analysis were also presented.

In the second session, the team delivered a presentation on the TIA ERP project. The presentation included the project objective, approach, working schedule and expected results.

The presentation triggered several questions and discussion regarding the development of the EERP for TIA and also the impact of the geotechnical investigation. At the end, participants were asked to voice their concerns, particularly on what considerations they would like the project team to study for the Plan development. Participants asked that the following major factors be considered while developing the plan:

- Security of airfield
- Volume of foreign humanitarian assistance
- Types of acceptable aircraft
- Customs, immigration, visa and quarantine procedures at emergency
- Contributions from the MoHA, NA, World Food Program (WFP), Asia Development Bank, World Bank, ICRC, and private airline companies
- Prioritization of structural assessments and ranking for rapid repairs
- Availability of ground handling equipment and the minimum need
- Line of succession for command and control
- Back-up plan for human resources
- Comprehensive strategy for risk mitigation, preparedness and response

- Link up with other documents including NDRF
- Time of disaster
- Delineation of roles and responsibilities among different agencies
- Availability of refuelling the aircrafts
- Link up with individual agencies response plan
- Emergency aid supply through airport
- Storage of cold goods and medical supplies
- Comprehensive approach to include disaster in other parts of the country
- Provisions for evacuation of foreigners
- Simplicity of the plan

10th July 2012

The project team traveled to TIA in the morning to setup its work area. Participants' input during the last day of the workshop were briefly revisited. Team members were engaged in initial brainstorming sessions to define a clear path forward to developing an all-hazard response plan. The team evaluated the main scenario (a large-scale earthquake) and its implication to the airport system. The goal of the plan was set to ensure that necessary steps are followed to take TIA from a state of disaster to a state of normal operations.

In the brainstorming session, the team documented concepts and ideas including assumptions to be made, critical procedures to follow, human and other resources, restoration priorities, and timelines.

The team collected several documents from TIACAO, including organizational charts, NOC procedures, and copies of the UN Cluster System and TIA response plans.

11 July 2012

Mr. Deo Chandra Lal Karna, Deputy Director of the Airport Operation Facility, made a presentation about the airport facilities, capacity, status, and future plans at TIA. After the presentation, the team met with the Aviation Safety Division staff of TIACAO. The team provided the representatives with an overview of the ERP project, and then requested input from the staff. Major input and comments from the Aviation Safety Division were:

- Currently TIA has an ERP plan that covers a bomb threat to an aircraft, hijacking, and a bomb threat to one of the TIA facilities. TIA is planning to revise their existing emergency response plan in couple of months. They would like to include contingencies for earthquake and medical/pandemic considerations.
- The Aviation Security Division is a focal point for airport security and is the responsible party to call upon the NP and NA when necessary. Security at the airport is primarily provided by the Nepal Police. There is a Security Coordination Center that manages security issues in the airport.
- If a large-scale earthquake takes place, staff from humanitarian agencies would require access to the aerodrome. In that case TIA would most likely issue permits to those parties.
- TIA has special assembly areas for emergencies. However, they do not have evacuation routes. The existing emergency exit plan has provisions to move people towards the ramps and airfield surface. TIA would like to modify this procedure so people congregate towards the parking lots instead.
- KMCTH is the primary medical responder to receive patients from TIA. There is also a resident doctor staff at TIA.

The project team also met with the Technical Service Department (TSD) staff. Major input and comments from the TSD are:

- It is the responsibility of TSD to maintain all equipment (electromechanical, communication, surveillance and navigation and other equipment), to provide technical services using equipment and to update/upgrade the technical resources.
- TSD has four engineers and 18 technical staff. They operate in three shifts, with a normal shift having two engineers and nine technicians.
- The TSD is unaware of the engineering capability of the NA.
- There is no backup radar or VOR/DME system. However, there is back up communication via satellite (one unit).
- There are several generators (including two heavy fixed for main supply) as back up for power supply.
- There is approximately four to five days' worth of fuel at the airport for generators at any one time.

Next, the project team met with staff from the Rescue and Firefighting section and the team gathered information about the firefighting capabilities of TIA. Additionally, the staff provided the following information:

- All airport units have extinguishers to put out small fires.
- If there were a large fire that exceeded the airport's capacity to respond, alternate firefighting service should be used. Since there is no additional equipment, firefighters from outside need to bring their own equipment.
- The airport fire service can cleanup some types of hazardous waste.
- The firefighting crew can perform light surface search & rescue extraction.
- Some of the firefighters are trained in basic first aid, but there is no regular training program.

The team also met Flight Operations Division (FOD) staff and the General Manager (GM) of TIA. FOD staff informed of the capacity of the division. They also provided input for helicopter operation in an emergency situation. The General Manager received the briefing from the project team. He confirmed that the role of operation commander in case of an emergency lies with the GM.

12 July 2012

The project team met with airline operators in the TIA office. Representatives from Simrik Air, Fishtail Air, Air Dynasty, Guna Airlines, Sita Air, Yati Airlines, Shree Air, and Air Kasthamandap and Oman Air attended the meeting. Following are the major points of discussion from the meeting:

- Although airlines have their own emergency response plans, they don't have earthquake hazards included. With this initiative, they are interested to include the earthquake scenario in their plans.
- Airlines acknowledged the situation that in case of a major earthquake, commercial flights may be suspended and only emergency response flight may take place for some time. Domestic airlines will be ready to provide emergency service including relief supplies and rescue operations
- Credit facilities may need to be established for provision of services under emergency conditions; large international airlines have credit facilities/capability to get funds for purchasing fuel, aircraft charter, ground handling, taking care of passengers, etc. Smaller domestic airlines may need to provide services initially without a guarantee of payment.

- Alternate/additional aircraft parking areas would be needed to address the emergency need.

Later, Mr. Deo Chandra Lal Karna provided information for disaster management arrangements under the Nepal Disaster Response Framework (NDRF). His main points were:

- Overall disaster management is the responsibility of the Nepal govt under the MoHA.
- Nepal is supported by UN clusters. At the Airport, the Log cluster will be run by WFP.
- Diplomatic agencies will also provide support.
- Nepal is currently working with diplomatic agencies to procure 20 pieces of heavy equipment to support runway repairs.
- Nepal is working with the UN to obtain special ground handling equipment for oversize cargo (\$10M)
- There are three components to this planning effort: runway status (susceptibility to damage), retrofit actions, and disaster planning

The team made a tour of airport facilities under the guidance of Mr. Deo Chandra Lal Karna. The tour included the site of back-up generators, airfield including hangers, ramp, runway taxi way, adjacent landscape, Buddha Air's hangar, potential spot for Humanitarian Staging Area (HSA) and Helicopter operation etc. The team also met with the staff of Buddha Air, the leading private airline operating in Nepal, in their office. Buddha Air showed their interest in the airport earthquake ERP and expressed commitment in compliance which included updating their own emergency plan to connect with the TIA earthquake emergency plan. They confirmed that the ground handling equipment will be provided for emergency operation in case of an earthquake.

Later, the project team met representatives of Nepal Air, Air India and Thai Airways. These airlines provide the ground handling service in TIA for international regular and cargo flights. They confirmed that the ground handling equipment and service will be dedicated to emergency flight operation in case of an earthquake emergency.

13 July 2012

The team conducted a meeting with the WFP which is the lead agency for the UN Logistics Cluster. Also, in attendance in the meeting were representatives from the ICRC. ICRC is normally involved only with conflicts; however, the representative was attending in support of the Nepal Red Cross Society. Discussions in the meeting were focused on emergency relief operation that would take place at the airport and the space availability/ requirements for that operation. Major points of discussion were:

- The UN Logistics Cluster has developed a very extensive Draft Contingency Plan (Apr 2011) for an earthquake response. The plan along with many other Nepal Log Cluster documents are found at: <http://www.un.org.np/coordinationmechanism/logistics>
- The plan identifies the WFP as Lead, with MoHA and MoL&T as Co-leads.
- The planning scenario assumes one million Internally Displaced People (IDP) requiring 16K Metric tons (MT) of food/month and a one-time 20K MT of non-food supplies.
- The Log Cluster plans to pre-stage 5 ea. 20'x8' containers at the airport (2 are already there) containing 30m x 20m storage tents (to be set up post incident for storing relief supplies), generators, water bladders, office kits, water purification, etc. to support the HSAs.
- The space requirement for one HSA would be 8 acres, 4 acres for the tent storage area and 4 acres for the Humanitarian Assistance workers (rough estimate of 1,000). Ideally, they would like to set up two HSAs, one by Buddha Air on the east side of the runway and one near the Cargo terminal on the west side of the runway (this area would require improvements to the infrastructure).
- The Log Cluster indicated that the Golf Course adjacent to the Airport will be used for IDPs and will not be available as a staging area.
- All other NGOs and donor countries would be coordinated through the Log Cluster and integrated into their operation and the Log Cluster HSA(s).
- The Log Cluster HSA would be used for staging Urban Search and Rescue and Medical Teams.

Extensive discussion took place with the civil aviation office regarding existing available space at the airport, potential development of areas and changes to the airport improvement plan to support HSA sites (especially at the north end where the runway will be extended). Several recommended changes were identified and summarized at the end of this planning visit. A critical requirement for an Immigration Emergency Plan and associated statute was identified. The ICRC representative explained that the Nepal Red Cross Society is not part of the Log Cluster, however, they coordinate closely and are an implementing partner; they are responsible for distribution of relief supplies from the HSA to the Points of Distribution in Kathmandu and on to victims of the disaster. They will contract local transportation.

In the afternoon, the project team met with representatives of NOC, a semi government corporation. NOC is the sole provider of fuel in the country including aviation fuel. In the meeting, the team explained the geotechnical investigation results, which indicated that the fuel farm is in the highest risk of liquefaction in major earthquake events. The NOC representative

was very concerned with the results of the study and understood the critical nature of the fuel farm. NOC staff indicated that they would call a meeting as soon as possible to come up with an action plan to mitigate the risk. The team gathered information on the fuel farm capacity, number and size of tanker trucks, fueling capability/hours, etc., which was used for airport throughput capacity calculations. The team provided a list of recommendations to the NOC representative for immediate and long term action items to address the seismic risk.

16 July 2012

A meeting was conducted with the UN Office for the Coordination of Humanitarian Affairs (OCHA), Humanitarian Support Unit (HSU) and the Nepal Risk Reduction Consortium (NRRC) Secretariat. The focus of the meeting was the overall command and control of Humanitarian Assistance, OCHA contingency plans and the interface/process that would take place between the UN, MoHA, the Logistics Cluster and the Airport for the prioritization of flights for slot allocation and the use of the airport for relief operations. The OCHA expressed appreciation for the analysis on the airport survivability that has been completed to date. They indicated that it has alleviated a lot of myths. Other major points of discussions were:

- OCHA indicated that the Gov't of Nepal's planning scenario is based on the JICA /Ministry of Home Affairs Study - Earthquake Disaster Mitigation in the Kathmandu Valley which estimates there will be 44,000 deaths/900,000 IDPs. However, the NRRC planning scenario is based on the National Society of Earthquake Technology – Nepal (NSET) study which estimates 100,000 fatalities and 1 million IDPs.
- Several UN/Cluster plans have been developed in addition to the Logistics Cluster Plan that was presented to the team the day before.
- NRRC will be conducting a large conference later this year where many potential international donors will be attending. They recommended that potential airport related projects be presented during this conference.
- Command and Control:
 - The National Emergency Operations Center (NEOC) which is managed by MoHA, is the focal point of command and control with the Nepal Government. The decision making body is the Central Natural Disaster Relief Committee (CNDRC) of which MoHA is a member and serves as secretariat. TIA CAO is also a member.
 - The UN Humanitarian Coordinator (HC) heads the international disaster relief operation supported by the IASC and OCHA.

- OCHA confirmed that the Logistics Cluster run by the WFP will be the lead UN cluster at the airport; all other clusters and international support that goes through the airport will be managed by /coordinated through, the Log Cluster HSAs, including Urban Search and Rescue and Medical teams. OCHA indicated that the Log Cluster has a very good working relationship with the Gov't of Nepal.
 - In addition to the HSAs, the only other space requirements at the airport are for emergency fuel operations (bladders/tankers, etc.), aircraft parking and the Nepal Red Cross Society.
 - The UN will set up two key management/coordination units adjacent to the NEOC.
 - The On-Site Operations Coordination Center (OSOCC) will provide a link between the international Community and the Nepal Gov't.
 - The Civil-Military Coordination Center (CMCC) will liaise with UN Agencies, Gov't of Nepal and providers on CMC issues, and registration of military and civil defense assets. Multi national /International Forces support the coordination
 - Note: OCHA indicated that MoHA Disaster Management Staff is small with one Joint Secretary, one Under Secretary and some junior officers and they are very busy with numerous internal Nepal and international planning efforts/meetings.
 - The Airport plan should address alternate airports for staging/fueling stopovers.
 - In the event that the Gov't of Nepal emergency operations capability is severely impacted, direct coordination to the OSOCC may be temporarily required while the Gov't of Nepal reconstitutes.
- Coordination Process for Prioritization of Flights for Slot Allocation:
- The primary coordination points are between the NEOC and the Airport ECC/Operation Commander and between the NEOC and the OSOCC coordinated by UN OCHA.
 - The Airport Operation Commander or designated section in the ECC, i.e. Air Traffic Operation Contingency unit, will inform the NEOC of available flight slots based on the throughput capability/Maximum (aircraft allowable) On-Ground (MOG). The MOG takes into account the airport operating status, refueling capabilities, parking and relief supply storage space available, off-loading/loading capability, etc. A key function of the Airport ECC will be a constant recalculation of the throughput/MOG and slot availability.

- The NEOC working with the OSOCC will prioritize which flights will fill those slots.
- The OSOCC will communicate the priority of flights with the International Community and coordinate with the Log Cluster.

July 17 2012

The team conducted the first meeting with security agencies: the NA, APF, NP, the NID and with NI. The meeting was focused on internal and external security at the airport in the event of a disaster, the roles and responsibilities for the security forces and capabilities. The team also identified the critical need for an emergency plan for immigration. Key Points regarding Airport Security that emerged in the meeting were

- NA will immediately implement “external” security of the airport perimeter and take over internal security initially if required until NP forces could assume command.
- NA will also activate humanitarian operations in the airport immediately after the event.
- NP supports the terminal and “internal” security at the airport during normal operations and emergencies.
- APF can augment both internal and external security operations. They also have search and rescue teams and equipment – currently 11 sets of Collapsed Structure Search and Rescue (CSSR) equipment which will increase next month to 38 sets. They can support SAR at the airport.
- For support to other disaster operations including clusters, the use of NA would be last resort with NP being first then APF.
- NP augmented by APF would control airport access and crowd control.
- All three security agencies will have representatives report to the airport Emergency Control Center (ECC) and to the Central, Regional and District Disaster Relief Committees where additional coordination will occur.
- All three agencies indicated that they have sufficient back-up to cover all security functions in the event of a major earthquake even if a significant number of personnel were impacted by the earthquake. They would bring in augmentation from outside of Kathmandu.
- Regarding NA capabilities for supporting rapid runway repair, they have some heavy equipment; however, most of it is deployed outside of Kathmandu Valley. TIA CAO

also does not have equipment and would have to contract it out. The Nepal Gov't has the authority to direct private companies to support emergency operations.

- The NA would be interested in being trained as a back-up to make rapid runway repairs if materials and equipment were staged at the airport. They would use their Engineer Construction Co.
- Provision of equipment and training for the NA for CSSR and well as Urban Search and Rescue (USR) should be recommended.
- The NP needs permanent space at the airport which would also be used for emergency response.

The second meeting was with representatives from KMCTH and NIH. KMCTH is located within 500m of the airport and Norvic hospital is in Thapathai (4-5) km away from the airport. Both hospitals have doctors/small medical teams that are stationed at the airport. Main points of discussion were:

- The combined capabilities of KMCTH and NIH could handle a couple of casualties and they would request augmentation from their hospitals if needed. They have 1-2 doctors, a nurse and admin staff on board during the two shifts 0700-1500 and 1500-2300.
- The airport Fire/Rescue would provide ambulance service.
- They have VHF handheld radios for emergency communications.
- They have no field hospital capability.
- They have critical need for spinal back boards, cervical collars, oxygen and defibrillators and first responder training for airport staff.
- Hospital capacities are already listed in the airport emergency response plan.

The third meeting was with the chief and deputy chief of the Civil Engineering Section, TIA CAO and the head of the Planning & Design Section where the Airport Improvement Plan is being managed. The meeting focused on:

- Accommodation of space for emergency relief operations
- Risk Reduction measures related to liquefaction
- Integration of both space requirement and risk reduction into the airport improvement plan
- Rapid runway repair

- Warehouse site selection
- Airport damage assessment

July 18, 2012

The project team had a meeting with the World Bank Nepal office in the morning. The meeting focused on areas where airport projects and World Bank projects might intersect producing areas for potential collaboration. Mr. Santosh Gyawali from the USAID Disaster Risk Reduction Office also joined this meeting.

Discussion ensued on any potential functional cross over of seismic instrumentation at the airport that could also record environmental data including temperature, rainfall precipitation etc. A staff from World Bank Nepal office, who is working on a Pilot Program for Climate Resilience (PPCR) strongly emphasized that any weather data from the seismic sensors must not be used for aviation/meteorological purposes as there are strict requirements for that type of data gathering. Also, there did not appear to be other possibilities for collaboration at the moment with the World Bank particularly with the earthquake emergency

The team had the second meeting of the day with officers of the MoHA. Mr. Laxmi Dhakal, Joint-Secretary, Planning and Services Division and Mr. Pradip Koirala, Under- Secretary, Disaster Management Section attended the meeting. The meeting focused on the command and control of disaster response in Nepal. The team also toured the Nepal Emergency Operations Center (NEOC) located next to the MOHA office.

Following are the major information and discussion points in the meeting with MOHA officers:

- MoHA confirmed that the Nepal Disaster Response Framework (NDRF) is still not implemented as it has not been passed by cabinet yet. However, this is already in the pipeline for ratification and will be in effect very soon. The Central Disaster Relief Committee (CDRC) is in place along with Regional and 75 District Disaster Relief Committees. MoHA Chairs the CDRC.
- Civil authorities are in-charge of authority of command and control during natural disaster response with the MoHA as the lead agency. Nepal Army falls under them for emergency response.
- The NP, NA and APF are members of all these disaster relief committees – tasking and coordination occur in the committees.
- The MoHA coordinates airport security with NP, NA and APF. They all have VHF communications with the NEOC.

- The Airport ECC has a VHF radio that can be used to communicate directly with the NEOC.
- Evacuation of Foreign Nationals will be coordinated by the Ministry of Foreign Affairs who will be in the NEOC.
- The MoHA confirmed that the Log Cluster will coordinate all disaster relief passing through the airport and no other clusters will be operating there. The WFP which leads the Log Clusters has been given direct communications with the NEOC.
- Immigration has an expedited process to expedite clearance of foreign disaster relief personnel.
- The decision to make an appeal for international assistance will be made by the Cabinet.
- The Chief of the NEOC will be the Point of Contact for setting the priority of relief flights. The chief will communicate directly with the Operation Commander to prioritize/fill flight slot allocations. The OSOCC set up by OCHA will be the link to the International disaster relief community. The Chief will set the priorities, OSOCC will communicate them to the International Community and the Operation Commander will control the flights.
- There are 11 CSSR (light) equipment packages. There will be 38 in the next couple months. They are training the NP, APF and NA teams. They are planning on developing two medium teams. One of the light teams could be directed to respond at the airport.

July 19, 2012

The project team provided an Out Brief of mission for CAAN, TIA CAO, US Embassy personnel, and USAID. Approximately 30 persons attended the out-brief meeting at the CAAN Conference Room. Director General, Deputy Director Generals and directors of CAAN, Defense Attaché COL Greg Winston and other US Embassy staff, staff of USAID office and staff of TIA CAO were present in the meeting.

The Team delivered a presentation that covered project objectives, planning process and schedule, scope of the EERP, the framework and tentative table of contents of the plan document. A list of the team's recommendation for risk mitigation and effective response were distributed. A draft of the Airport land use plan for earthquake emergency was also presented.

September 17, 2012

Project team members reached Kathmandu on 16th September 2012 to start the second mission of the project. Several meetings and workout sessions were held during this mission. The primary

objective of this mission was to finalize the draft plan document incorporating stakeholders' feedback and further input.

On the first day of the mission, September 17, 2012, two meetings were conducted. In the first meeting, the Team briefed the UN Office for the Coordination of OCHA, UN Logistics Cluster, the NRRC Secretariat, and the USPACOM (US Pacific Command) Augmentation Team from the US Embassy. Later, the team met with the officers of (CAAN), and TIA CAO to review the initial draft of the plan and to plan out this week's meeting schedule.

Major input from the first UN office meeting included the following:

- The Log Cluster is now working on raising funds for funding staging areas – site prep, more pre-staged equipment and for purchase of fuel bladders and pumps for jet fuel. They presented a proposal to the Resident Coordinator (UN OCHA). They will need to demonstrate that there is a commitment by the Nepal government and the airport authority for supporting the HSAs initiatives.
- The Airport Site Plan needs to have an area for bladders.
- The UN Logistics Cluster has a plan for HSA equipment and supplies staged at the airport - two containers staged at the Domestic Terminal with equipment/supplies for office space and sleeping quarters and two containers staged at the Cargo Terminal containing tents for storing relief supplies at the HSAs.
- Ms. Moira from Nepal Risk Reduction Consortium indicated that the NDRR Conference with donors that was tentatively scheduled for next week has been postponed with no set date. She didn't think that there would be substantial donations for Logistics (including the airport). She emphasized that whatever is presented needs to show that there is coherence between the various plans – the NDRF, Log Cluster Plan and the Airport plan. The project team emphasized that extensive coordination has occurred to synchronize these plans. She suggested that any Airport DRR related projects have a rough cost estimate and be presented to the Defense Attaché's from various countries and the DRR Consortium. This would be done through MoHA.
- OCHA indicated that as a result of the Airport planning they have requested an additional funding of \$10-12 million for the airport logistics project implementation.

In the afternoon, a meeting was held with CAAN and TIA CAO officers. The team presented the initial draft of TIA ERP. The group determined that several workout sessions with TIA staff for point-wise discussions of the draft plan document were needed. In addition to CAAN/ TIA staff, additional meetings with NOC, AOA and UN log cluster were necessary.

In the discussion after a quick run-through of the draft plan, CAAN director, Dr. Shakya suggested that checklists be developed for each line agency in CAAN and TIA. This was later done using the Synch Matrix – creating tabs for each agency that have all their actions and a check box. The current initial draft of the plan was sent out to all Nepal Gov't and UN parties for comment.

September 18, 2012

The team engaged in a work out session to revisit the draft plan with TIA and CAAN staff. Today was dedicated to a line by line review of the draft Airport Earthquake Emergency Plan with 12 TIACAO and CAAN Department Directors and Division chiefs. Dr. Shakya, Director, CAAN Department of Safety and Standards and Mr. Deo Chandra Lal Karna, TIACAO Director, Operation and Facilitation Department were also in attendance.

The group completed a line by line review of sections 1 and 2 of the plan. These were the critical sections for CAAN and TIA Divisions/Departments to work through with the Command and Control arrangements and roles and responsibilities. The discussion finalized the name of the plan document to be “Tribhuvan International Airport Disaster Response Plan (TIADRP)”. Additional review of Sections 3-6 will occur over the next couple days with appropriate staff. It was decided that Section 8, Recommendations, will be deleted and published separately. Section 7, Synch Matrix, will be updated once all sections have been reviewed. Checklists will be created for each Division and Department straight from the Synch Matrix.

The objective of having all Division and Department Directors in attendance was to ensure that all parties of the plan are familiar with details of the plan and are part of the decision making. Numerous internal CAAN/TIA issues were resolved during this meeting.

September 19, 2012

A meeting was held with NOC, ICRC representing UN log cluster and the AOA to discuss their plans for emergency fuel re-supply in the event that the fuel farm is damaged and the roads and bridges from India are blocked. Although the Log Cluster Contingency Plan contains some information on emergency fuel supply operations, there is no comprehensive plan to coordinate the organizations that would be involved with such an operation. The following general arrangements roles and actions were identified by the group. This information along with some background information on Nepal Oil operations will be added to Section 6 that forms a very basic emergency fuel plan. The plan was sent to the WFP, the UN Log Cluster Lead for review.

Discussion was had with TIA operation department staff and the following are provisions in the draft plan and in the list of recommendations which were confirmed by them:

- Provide space on airport for bladders including site prep/grading, etc.

- Issue NOTAM on status of fuel at TIA/guidance to aircraft on alternate fueling points to be coordinated post disaster with MOHA and UN Clusters.
- Request through NEOC, additional flight entry points for emergency relief flights including fuel through India and from the east and west.
- Operations Commander provides guidance to NOC on which aircraft to provide fuel which will be based on information received on priority relief flights from MoHA.

September 20, 2012

Work out sessions continued with TIA and CAAN directors and unit chiefs. Section 3-5 has been completed with line-by-line review of the draft plan. The Log Cluster Lead provided comments on Section 6 Logistics via email and revisions were made. The updated draft plan was sent to the NA for final comments.

September 21, 2012

The team met with TIA technical staff to make a final revision of the Airport Emergency Site plan and to develop the Throughput and Rapid Repair appendices.

The team also conducted a site inspection of the NOC's fuel farm at TIA. The team met with NOC's staff and inspected the oil tank site, general layout (landscape) of fuel farm and pipe connection. Simple measurements were made and photographs of the site were taken for further analysis.

Later in the afternoon, the team met with Embassy Staff, MAJ Dawood Luqman, Chief, Office of Defense Cooperation and Chris Johnson and Drevino Woods from the PACOM Augmentation Team (HA/DR), to brief the planning projects and recommendations status.

September 22, 2012

The team worked to finalize the plan document and other resource material throughout the day. The team finalized the draft TIADRP, added appendices, completed the recommendation list, prepared an executive summary, updated the liquefaction potential map, updated the land-use emergency operation plan map, and prepared the final presentation summarizing the project and TIADRP.

September 23, 2012

The project team traveled to CAAN headquarters at Babar Mahal and met stakeholders to brief them on the final draft version of the TIADRP. At the meeting, prominent stakeholder agencies included CAAN, TIACAO, NA, UN OCHA, WFP, US Embassy Nepal, USAID, OFDA etc.

Mr. Justin Pummel, USACE presented the TIADRP which included, project background, objectives, framework, section contents, and emergency land use map of airport, appendices, checklists, synchronization matrix and list of recommendations.

Director General, CAAN, Mr. Tri Ratana Manandhar made a brief statement about the project and the Plan. Major points he raised in his statement were:

- Words of thanks to USACE, FAA and UBC for this work that is extremely valuable to Nepal.
- CAAN will use the results of the geotechnical investigation in all planning works now onwards.
- Since integrating earthquake and natural disaster risk into actual practice is new to CAAN and TIA, this emergency response plan is eye opening to us and CAAN and TIA will make every effort to consider natural hazards in all of their efforts.
- CAAN and/or TIACAO will be procuring some heavy equipment to implement some of the recommendations made in this project.
- CAAN and TIA would need continuous support from donor agencies and other agencies to implement this plan and the recommendations.
- CAAN will present this plan as a showcase example in the Asia-Pacific Director Generals of Aviation meeting scheduled for the second week of October 2012 in New Delhi. This will make them proud that this sort of development will be new and encouraging to other countries around.

A brief discussion followed the presentation and Director General's statement. Concerns were raised to enhance the capacity of TIA staff to properly implement the plan including the ability to do throughput calculation. A quick follow-up action would be needed to have an authentic scale drill of the plan as soon as possible.

3.4. Preparation of Report

This report has been prepared to briefly explain the project, methodology of implementation, its major activities, lessons learned and future works. A list of recommendations for risk mitigation and effective implementation of a DRP is provided in a separate document. As a major deliverable of the project, the following has been delivered with this report:

- **Airport Earthquake Emergency Response Plan for Tribhuvan International Airport.** A self-standing airport earthquake emergency plan has been developed. The plan considers two phases: emergency response of the airport covering activities before,

during and immediately after the earthquake; and airport operation for emergency aid supply in the aftermath of the earthquake for smooth transit and distribution of emergency personnel and relief material to the affected areas.

- **Guidelines for post-earthquake assessment of the airport system.** The methodology included in the guidelines provides a step-by-step procedure for conducting post-earthquake assessment of airport facilities and criteria for tagging them (Green, yellow and Red). This is based on rapid visual inspection techniques.
- **Rapid repair kit for airport runway.** This includes a list of items and their storage in non-emergency time and usage in the aftermath in case the runway gets damaged during a major earthquake. A sample of quick repair of airfield pavement is also illustrated.



4. Concepts of TIA Disaster Response Plan

4.1. Assumptions

The project team made some assumptions in the course of formulating the provisions of the TIADRP. The team attempted to make the plan as comprehensive as possible and at the same time to make it specific to TIA. The team agreed that the assumptions made for the plan are valid in the most likely scenarios of an earthquake event. However, specific situations in the disaster may slightly differ. Attempts were made to ensure minimal adjustments would be needed to address the changed situation, if any. Likelihood of a situation that significantly differs is considered to be low.

The major assumptions made in the TIADRP were:

- A. There will be no other concurrent large disasters in Nepal.
- B. There will be no labor strike, and normal operations are carried out with the full airport staff on hand.
- C. The airport runway is well maintained and fully functional for normal operations.
- D. The NA is functional in the immediate aftermath of an earthquake event and is available for immediate action.
- E. Full access to the airport is feasible within 72 hours after an earthquake disaster.
- F. A temporary power supply at the airport is available for emergency operations.

The assumption of fuel availability in the airport in the event of an earthquake would make the plan marginally simpler. However, considering the risk of the fuel farm site to liquefaction potential, and likelihood of damage to the fuel farm facilities access road and non-structural seismic vulnerability of the facilities, the plan demands to have an alternate back-up plan for fuel. Provisions for bladders in the airport and notification to emergency operation flights inbound to Kathmandu to have enough fuel for returning at least to the nearest Indian airports are considered.

It was learned that a meteorological hazard, particularly flooding may happen in Kathmandu. However, the airport itself is less likely to be affected by the flood as experienced in the past. Concurrent flooding situations in Kathmandu may demand higher inflow of relief material, which can be well accommodated in the plan.

4.2. Earthquake Scenarios

The disaster response plan developed for earthquake hazard considers disaster scenarios in a range from low intensity shaking to catastrophe. Some or several provisions of the plan may not be activated in small earthquakes. On the other hand, if the earthquake event is very big and destroys most of the airport facilities, the plan is limited to be active to divert the airborne flights inbound to TIA. In such a situation, a complete rehabilitation of the airport is necessary, which falls under the Nepalese government's recovery plan.

The situation that demands activation of most of the provisions in the plan is a large size earthquake that would affect the airport facilities but limited operation is possible with quick repair of the runway. The most likely runway scenario is that 80% of it is available right after the earthquake, which is enough to have C-type aircrafts land in daylight Visual Flight Range (VFR). This is based on results of geotechnical investigations carried out in the airport sites prior to development of this plan. The scenario earthquake of the analysis was a 7.6 magnitude earthquake that would trigger 0.35g acceleration at the surface of the airport field.

Figure 4.1 illustrates the range of earthquake scenarios that the plan is considering.

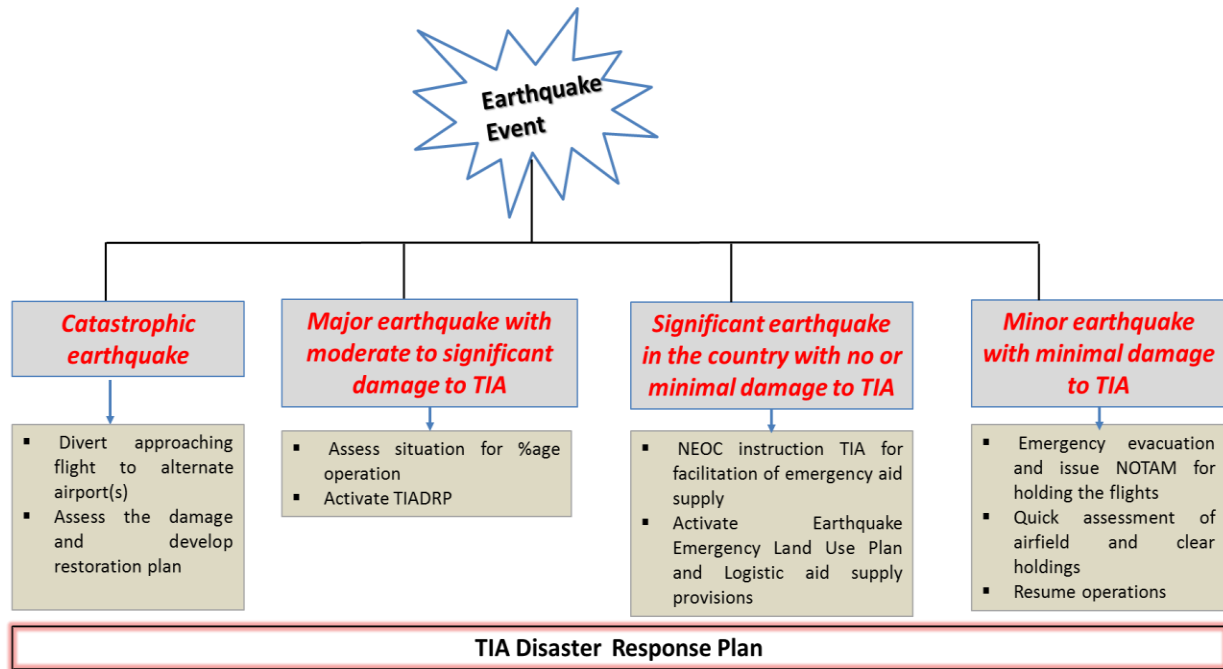


Figure 4.1 Earthquake scenarios considered in the TIADRP

Four distinctive earthquake scenarios with significantly different activation plans are:

- i. *Catastrophic earthquake*: The severity of the earthquake is profound. As such, most of the airport runway and other critical facilities are destroyed and/or severely damaged. No flight operations are possible for an extended period of time in the aftermath of the earthquake.

Notice to Airman (NOTAM) will be issued with the status of the airport which will trigger airborne flights inbound to TIA to be diverted to the nearest airports and all other scheduled inbound and outbound flights will be cancelled. The Manager-on-Duty informs CAAN and NEOC about the situation. The government of Nepal will take care of recovery action as appropriate.

- ii. *Major earthquake with moderate to significant damage to airport*: The severity of the earthquake disaster is medium to high. As such, airport facility damage is moderate to significant, requiring immediate repair for emergency flight operations. The runway is available, but requires rapid runway repair.

The plan is activated in its fullest. Emergency actions including communication and command and control are established. Rapid assessment of damage and quick repair actions will be taken to maximize the flight operations. Earthquake emergency land use plan will be in effect for relief aid supply.

- iii. *Minor earthquake with minimal damage to airport:* The earthquake is small. The damage to airport facility is minimal and continued operation is possible. Some repair may be necessary for effective operations and to return to completely normal operations.

The shaking of the event may trigger emergency evacuation of airport tenants and transient passengers. NOTAM is issued that would require airborne flights to be in holding position. As soon as the General Manager (GM) or Manager-on-Duty (MoD) of the airport assess the situation based on reports from quick field inspection and casualty information from unit chiefs, another NOTAM will be issued, which would clear the holding position of airborne flights. Regular operation will be carried out. The GM or MoD shall not activate the earthquake siren.

- iv. *Significant earthquake in the country with no or minimal damage to airport:* The damage to the airport from an earthquake is minimal with no functional loss. The earthquake may, however, induce significant damage to other parts of the country, requiring major relief aid transport through TIA.

NEOC shall instruct TIA CAO to handle the relief aid coming to the country from foreign countries by air. The part of the plan that deals with logistic aid supply and Earthquake Emergency Land Use Plan will be activated.

4.3. Performance Objectives of the Plan

The TIA DRP aims to achieve the optimum use of available resources of TIA with continued flight operations to support disaster rescue and relief in the country during the earthquake disaster situation. Earthquake emergency restoration by achieving maximum possible flight operations to meet the needs of the emergency situation as quickly as possible is also the part of the performance goal of the plan.

The continued operation of the airport will be achieved by use of emergency command & control mechanism. Emergency actions are set to ensure the activation of command and control structure and safety of airport tenants and passengers. Emergency communication systems will support these objectives. Rapid assessment of facilities and quick repair actions are designed to restore the facilities at the earliest. The earthquake emergency land use plan and logistic operations are designed to support the country's disaster rescue and relief operations.

Figure 4.2 illustrates the expected performance curve timeline for the airport after an earthquake event. The following priorities are set to the expected performance of the airport operations. Restoration of flight operations are set and established, in increments, Visual Flight Rules (VFR) in daylight and Instrument Flight Rule (IFR).

- A. Restore Airport Perimeter Security
- B. Restore Flight Operations
 - a. Restoration of Runway, Taxiway, and Ramp Areas
 - b. Restore Navigational Aid (NAVAID) and Air Traffic Control systems
- C. Restore Fuel Operations
- D. Establish Emergency Customs and Immigration
- E. Restore Terminal Facilities
- F. Support Logistics Cluster Operations
- G. Maximize Aircraft Throughput

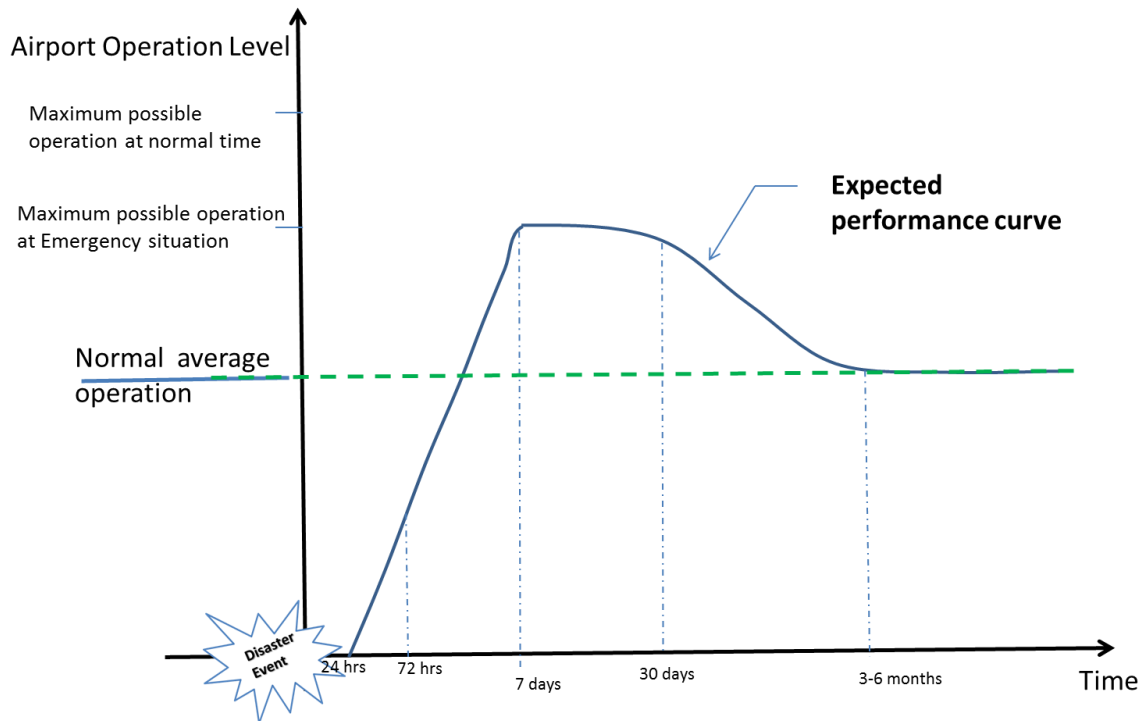


Figure 4.2 Performance objective curves for the airport operation

4.4. Framework

The TIA Disaster Response Plan is developed to be a stand-alone document. The legal, institutional and logistical framework of the plan, however, lie in the existing arrangement of the countries law, national disaster response framework and other disaster risk management plans.

This plan supports the NDRF of Nepal. In the event of an earthquake, the Airport Emergency Control Centre (ECC) will be in continuous communication with NEOC regarding the status of the airport and flight operations. TIACAO will prioritize restoration of the airport facilities and flight operations to provide space for UN Logistics Cluster operations and to maximize aircraft throughput. NEOC will coordinate the priority disaster relief requirements with OSOCC as mentioned in NDRF and will communicate priority flights to the ECC so that limited slot allocations may be properly managed.

Though being a stand-alone document, the plan is developed in line with the existing Airport Emergency Plan (AEP) that addresses other emergencies like aviation accidents, bomb threats etc. Efforts are made to make the provisions in the plan that follow ICAO standards and in tandem with international practice like FAA guidelines for emergency flight operations.

4.5. Characteristic Nature of the Plan

The basic premise of the TIA DRP is that it should be implementable to the specific setting of Kathmandu. The project team made efforts to make the plan compatible with the specific circumstances including hazard, institutional framework, available resources and technology, and need for improvement. Another important aspect is accommodating the stakeholders' perceived concerns.

The focus of the team was not only the delivery of the plan but the process of its development. The team attempted to steer the following characteristics of the process and outcome so that the actual implementation of the plan would be effective. These are the guiding principles of the project.

Applicable to TIA Conditions

The plan should be applicable to the specifics of TIA. Any standard provisions in the international practice of the emergency response plan that do not fit the Nepalese case are dropped out. For example, the command & control structure was streamlined through the MoHA instead of city office, which is the usual practice in North American airports. Administrative arrangements were made simple to reflect the small institutional infrastructure. Provision of HSA in the airport is made considering the country's need to get help from outside for rescue and relief. Coordination with the United Nations Cluster for disaster preparedness is warranted to reflect the situation at hand.

Simple and Clear

The plan is made as simple as possible. Technical terminologies are kept minimal so that everyone who needs to understand the plan is familiar with it. Any technical matters that require special skill to understand and apply are placed in appendices. Attempts are made to avoid cross reference as much as possible. The action items are stipulated in the timeline order. At the same time, consistency is maintained for priority and institutional hierarchy for parallel items.

Resource materials to support the plan are also made simple and visual. Step-by-step procedures are laid out in the technical document.

Imperative Format

The core part of the response plan is written in instructive format. This helps authorities to follow the action item in order. This also helps to make the plan succinct and efficient. The emergency nature of the situation when the plan would be implemented also warrants documents in instructive format. Since the plan would be considered a semi-legal document once it is ratified by the airport aviation safety committee, this writing style also corresponds with the practice of SOP.

Evidence Based

Results of seismic vulnerability assessment of airport facility conducted by SMEs from the FHWA, FAA, U.S. Office of Defense Cooperation (Kathmandu), USAID and USACE, geotechnical investigation of airport sites and pavement condition investigation by USACE are taken into account to derive the plan. The project team made field visits of the airfield and other airport facilities to confirm the data gathered. Most of the agencies mentioned in the plan were asked to confirm the provisions stipulated in the plans that are related to them and the project team received the verifications.

Ownership Taken by Stakeholders

One of the important aspects of the document is that stakeholders and concerned agencies own the plan document and its provisions. This is made possible by consulting them for their input, taking them into confidence while developing the document and getting their feedback on the draft document. Actually, the final draft documents were run with TIA and CAAN staff line by line. All of their concerns were addressed and the document was finalized with them. Their standpoint took precedence unless they contradicted the very function and objectives of the plan. This process provided the ownership of the document to stakeholders themselves.

Tested in the Field

During the interactions with stakeholders, they are asked to test some provisions in small mock drill exercises. In some meeting sessions, several TIA staff were present to conduct the drill exercise. Some modifications were made to the draft document reflecting the outcome of the mock drills, particularly in emergency communications.

There is a need to determine how to conduct a large scale drill including emergency actions, rapid assessment of damages, and airport throughput calculations.



5. Contents of the Plan

The TIA DRP document contains six sections and eight appendices. The main document contains prescribed institutional arrangement, communication structure, action items and provisions to follow. Appendices are resource documents for effective use of the main document and provide supplementary information. They also include technical information and detail procedures for specific action of technical nature.

Major features and content of each section of the main document can be summarised as below.

5.1. General (Section-1)

This section forms the basis of the document and its applicability. It includes purpose, source of authority vested to exercise it, conditions to arise for its activation and related procedure, and the procedure for document updates and distribution. It also includes specifics related to earthquake disaster scenarios, list of response actions by agencies, and basic premise of the communication flow chart. The section also contains the summary table of responsibility matrix for agencies.

5.2. Command & Control (Section-2)

Section 2 deals with command and control structure in an emergency situation. There are two layers of authorities to manage an emergency in the airport: ECC led by Director General of CAAN and the General Manager who will assume the role of Operation Commander. ECC provides interface between the airport and external agencies including government bodies, UN and other foreign missions, and international organizations. It provides the directives to TIA to implement government decisions related to disaster rescue and relief works that involve TIA's role. Operation Commander, on the other hand, has responsibilities and authorities to implement the actions laid out in this plan in TIA. In order to meet the emergency need, the line of command and feedback is centralized through Operation Commander.

This section defines the line of succession for key positions, their authorities, details of ECC and roles and responsibilities of all stakeholders including all department and units of TIA CAO, MoHA, NEOC, security agencies, NOC, airlines, hospitals, UN agencies, government departments etc. The roles and responsibilities begin at the instance of the earthquake event and carry on to the relief period.

5.3. Emergency Communications (Section-3)

This section is devoted to communication function in the emergency. It defines the communication structure in three phases: Immediate Response (0-24 hrs.), Response (24-72 hrs.)

and Recovery (72+ hrs.). It provides the details of the communication lines and the content of the message. The structure includes both internal as well as external communication. The flow of communication to and from NEOC is detailed in this section. Communications are categorized into two types: order or instruction and reporting/ notification. The section also includes back up procedures and equipment and air traffic frequencies. Figure 5.1 shows a comprehensive Emergency communication flow chart.

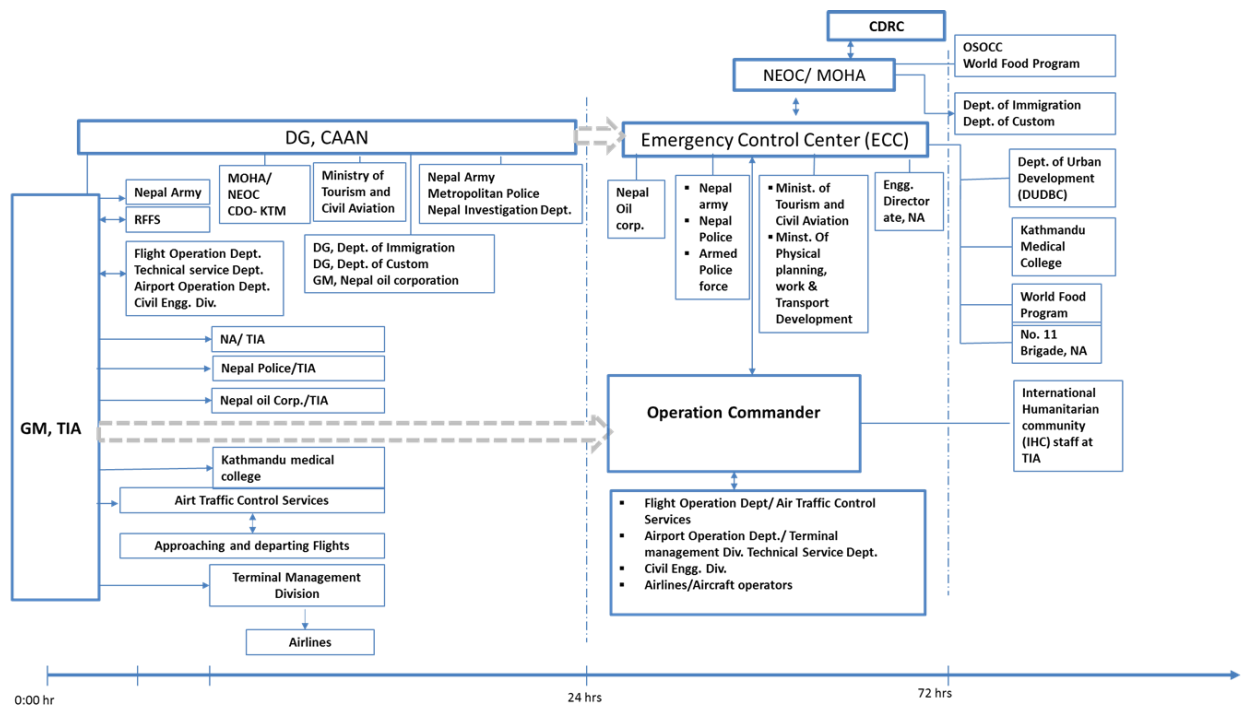


Figure 5.1 Emergency Communication Flow Chart

5.4. Emergency Actions in the Immediate Aftermath of an Earthquake (Section-4)

Section 4 provides clear procedures to follow right after the earthquake event including evacuation and assembly and headcount. The action items for each agency are listed in the time order. Action items in this section are critical to make transition to changed situation and establish control. Life safety of airport tenants, passengers and safety of flights are given priority in formulating these actions.

5.5. Airport Emergency Restoration (Section-5)

Section 5 deals with airport emergency restoration that would enable the airport to acquire more flights needed for disaster rescue and relief. As the scenario earthquake would leave the airport facility partially damaged, actions for rapid restoration of facilities are critical for airport

operation. This section details the composition of the Emergency restoration team and its function, describes the procedures to perform RVA of airport facilities including airfield, building, equipment, utilities and other OFCs. It also gives reference to possible damage situations of the airfield, visual guide for damage assessment of building components and sample quick repair method of pavement. The results of vulnerability assessment of airport facilities, geotechnical investigation and pavement condition investigation provide complimentary information to the procedures described here.

5.6. Logistics (Section-6)

This section describes how TIA will be used to support humanitarian assistance operations after an earthquake event that affects the country. One of the important constituents is the earthquake emergency land use map which depicts the location of various emergency operations including humanitarian staging, emergency fuel, repair kit etc. It also includes procedures for fuel management and emergency air operations. The information and provisions contained in this section are tied up with the UN Logistic Cluster Plan.

5.7. Appendices

The plan document contains a total of eight appendices which are the integral part of the main document. These appendices contain information, data and technical know-hows that are needed to carryout actions listed in the main document. The information contained in these appendices may need continuous updating and revisions as further information is available. Updating the documents is simple and straight forward as they do not interfere with the provisions of the main document. The appendices of the TIADRP are:

- i. *Appendix I: TIADRP Distribution List*
- ii. *Appendix II: Airport Grid Map*
- iii. *Appendix III: TIA Emergency Telephone Directory*
- iv. *Appendix IV: ATC Capacity*
- v. *Appendix V: Examples of Earthquake Damage of Airfield*
- vi. *Appendix VI: Rapid Visual Assessment of Masonry and Concrete Building Components*
- vii. *Appendix VII : List of Equipment at TIA*
- viii. *Appendix VIII: Example of Rapid Repair of Airfield Pavement*

6. Observations and Lessons Learned

In the execution of the project, we learned some lessons that are derived from observations, interaction with agencies and outcomes of project activities. The context and unique characteristics of the project site also offered new insights to the problem. Important observations and major lessons learned from the project follow:

1. Vulnerability assessment and geotechnical investigation prompted stakeholders to produce an Emergency Response Plan.

In the meetings, the officials of CAAN and TIA mentioned the results of the vulnerability assessment and geotechnical investigations were eye-openers to them. The fact that an earthquake emergency response plan is a must to any airport that has seismic hazard might not simply be enough to convince the stakeholders to produce an ERP. Results of those studies provided convincing evidence of the risk and instigated the agencies to take actions for remedies. It was also reflected in the statements from the Director General, CAAN during the missions. The results of the studies, hence, not only provided the basis for planning, but also served as catalysts.

2. Logistics plan for humanitarian assistance needs to be an integral part of the Emergency Response Plan

Existing airport earthquake emergency response plans for other airports have limited or no provisions for managing foreign humanitarian assistance supply in the airport. This is due to the fact that those plans are prepared for developed countries that may not need large volumes of foreign assistance. When the foreign assistance is needed, channels other than the affected airport would be available to supply those needs. TIA, which is the only international airport in land-locked developing countries, is the only means to supply the humanitarian assistance. These unique characteristics demand that the logistics plan be an integral part of the airport ERP. This would be applicable to other airports of developing countries that need foreign assistance in disasters.

3. Improvements to current states of preparedness are necessary to provide the base level for the Emergency Response Plan.

Emergency response plans are ideally based on the current state of infrastructures and operation practice. However, high levels of existing vulnerabilities in TIA add up to the complications to the plan that may render the plan inoperable. On the other hand, it is observed that a little intervention could improve the situation significantly and form a solid base so the ERP can be executable. Those necessary interventions are listed in the recommendations and the project team received a commitment from the TIA authorities that they will be fulfilled as soon as possible. Some examples of these actions are tagging equipment with information of maker, model number and input voltage so that repairs can be done within hours by technicians from outside,

changing the current evacuation routes towards ground side from airside, secure the communication equipment so that it is available for operation right after the earthquake event, and maintaining full fuel levels for generators, etc.

4. Emergency Response Plan is a dynamic document and needs continuous updates.

Since the emergency response plan is developed taking into account existing institutional arrangements and current airport infrastructures, any changes to the situation in the future need to be reflected in the plan as they happen. Obvious changes like contact details of stakeholders and updates in the equipment list can be made by updating corresponding appendices. However, any major change in administrative structure of CAAN, TIA or changes in the laws that regulate airport functions or disaster management would need an update of provisions in the main document.

5. Stakeholders' buy-in is possible through their engagement in the process and ensuring their concerns take precedence.

The approach that the team took executing this project is engaging stakeholders in the process of formulating and finalizing the plan provisions. In the first mission, the project team first developed a general framework in the stakeholders' consensus and collected the information. More importantly, the team also asked each individual authority of TIACAO and CAAN to give concrete input for the plan in the given framework. Their input was duly taken into account while developing the draft plan. In the second mission, each and every provision of the plan was put in the table at the meeting with them one at a time to get their review and feedback. Stakeholders concerns were fully addressed and their revisions were incorporated as appropriate. This led to confidence-building and they took complete ownership of the plan outcome and the process as well.

6. The initiative made impact beyond its original scope.

The development of the emergency response plan did not go as an isolated effort. In fact, the process has triggered several other initiatives. CAAN and TIACAO expressed keen interest to purchase new equipment and plants for the airport. UN Cluster group took the initiative as a showcase and plan to use it to generate funds for the logistic cluster. Officers from MoHA took the plan to use as a template for when they ask many more agencies to follow suit. Follow-up activities like training TIA staff, building a warehouse to store perishable relief material and runway emergency repair kits were identified from the project itself.

