III. B. 2. DETAILED STOCKTAKING (SECTORAL ASSESSMENT)

INTRODUCTORY REMARKS

Whereas the above section dealt with principles and problems of stock-taking in general and the requirements of quantifying stock-taking needed to establish exposure to earthquakes we shall now consider stock-taking from the angle of sectoral assessment. The tables presented herunder will be of assistance as check lists during an intial evaluation of risks but also when completing the final study.

A top priority is to conduct a detailed vulnerability assessment of the existing building stock as explained in the preceding section to determine potential losses under various threats. This is important for several reasons: first, only by determining the total losses that could occur can emergency services be planned properly and the scope of post-emergency requirements be delineated; second, the process will identify critical areas that should receive priority attention in vulnerability redution efforts. For examle, it may identify weakesses in schools, high-occupancy public buildings, or other typs of high-occupcy residential structures. These would then receive priority over other structures for reinforcing or replacement.

In carrying out the stock-taking, it is important to consider two things: the expected return period of the threat, and the percentage of time that a particular structure will be occupied at its peak capacity. It is stresses, however, that remedial steps considering occupancy only will not mitigate the physical loss or damage an earthquake can cause to the national economy. The return periods of earthquakes in Armenia are relatively long if we compare them to those of the very seismic zones of the globe and the likelihood that any one site would be very close to the epicenter of a strong earthquake within a millennium is not high. On the other hand, depending on the site, damaging floods could occur on a more frequent basis and therefore would require more immediate attention.

School buildings have a high occupancy for approximately one-third of a day. Auditoriums that periodically hold more people may only have peak occupancy an average of 1/200th of a day. Therefore, schools would have a higher priority than an auditorium.

Retrofit of existing buildings, especially those with inherent construction problems, is likely to be very expensive. Since the return period of earthquakes is long, it is recommended that emphasis be placed on improving the quality of construction of new structures and limiting the retrofitting to those that have high occupancy and long peak occupancy periods.

SECTORAL ASSESSMENTS

To this point we have discussed stock-taking in terms of specific hazards. Another way to evaluate aggregate losses is by sector (e.g., housing, infrastructure, agriculture, industry, etc.). Determining the aggregate vulnerability in each sector is an important alternative method to the more common hazard-based method because it parallels the way governments assign ministerial responsibility. For example, housing is normally the responsibility of a housing ministry or a state committee for construction; agriculture is the responsibility of an agricultural ministry or committee; industry is the responsibility of an industrial development authority or ministry; etc. By planing vulnerability reduction by sector, ministries can more easily identify their roles and responsibilities, and vulnerability reduction can be easily accommodated and integrated into normal development planning and implementation processes.

The following tables (III-A,-B and -C) present simplified outlines for the process of conducting sectoral vulnerability assessments for the housing, agricultural and industrial sectors.

TABLE III-A: OUTLINE FOR ECONOMIC VULNERABILITY ASSESSMENT

I. Steps in Planning a Program

A. Establish a planning team

B. Select personnel

1. Professional staff:
   a. Micro-economist
   b. Macro-economist
   c. Industrial facilities specialist
   d. Agricultural economist
   e. Constrution economist

2. Semi-professional staff:
   a. Cartograper
   b. Draftsman

3. Clerical staff
   a. Secretary
   b. Clerk-typist

C. Collect data

1. Risk mapping
   a. Define threats or natural hazards
      1) flooding
      2) wind damage
      3) mud slides
      4) earthquakes
      5) industrial accidents

   b. Identify threatened sites (industrial sites and surrounding areas, cities, regions, etc.)

2. Vulnerability mapping
   a. Identify economic sectors at risk
   b. Map areas where economic vulnerability is high

3. Collect environmental data
   a. Climatic data
   b. Rainfall
   c. Soil typs
   d. Topographic data
   e. Hydrologic data

4. Determine the economic impact of various hazards on the economy
   a. Conduct a hazard and risk analysis
   b. Determine the degree of probability
   c. Prepare risk maps
   d. Estimate the gross economic loss
   e. Estimate the potential net economic loss
   f Determine the overall impact of the net economic loss

5. Determine the social cost of economic losses
    a. Evaluate impact of economic losses on unemployment
    b. Evaluate impact of relief on reconstruction costs
    c. Assess impact on private and public debt

II. Explore Disaster Mitigation Alternatives

A. Establish priorities for vulnerability reduction

B. Identify and study alternatives for reducing the economic impact of disasters:

1. Adjust normal development programs to reduce losses
2. Determine if retrofitting of structures can reduce vulnerability of key economic facilities
3. Explore economic diversification
4. Use strategic investment to steer vulnerable indstries away from hazardous areas
5. Explore focusing development on "disaster resistant" economic activities
6. Explore economic methods to help mitigate losses (disaster insurance, cash pools, etc.)

III. Develop Specifications, Programs and Strategies for Reducing Economic Vulnerability

TABLE III B: OUTLINE FOR HOUSING VULNERABILITY ASSESSMENT

I. Steps in Planning a Program

A. Establish a planning team

B. Select personnel

1. Professional staff:
    a. Engineers
    b. Architects
    c. Construction managers
    d. Housing financial specialists
    e. Housing economists

2. Semi-Professional staff:
    a. Cartographer
    b. Draftsman
    c. Construction site managers
    d. Quality control supervisors

3. Clerical staff:
    a. Secretaries
    b. Clerk-typists

C. Form a project adisory committee

1. Representatives of tenants' groups

2. Senior staff of the housing ministry

3. Represenatives of key municipalities

D. Collect data

1. Risk mapping
    a. Define threats
        1) earthquakes
        2) flooding
        3) mud slides
        4) windstorm
        5) industrial accidents

    b. Identify threatened sites and structures

2. Vulnerability mapping
    a. Identify vulnerable structures
    b. Map unsuitable soils
    c. Map areas with concentrations of vulnerable structures
    d. Identify areas of high occupancy ratios

3. Identify secondary threats resulting from various disaster typs including:
    a. Secondary flooding
    b. Hazardous material spills created by flooding or earthquakes
    c. Areas at risk from fire caused by earthquakes or secondry explosions from chemical or indstrial accidents, and contamination

4. Estimate losses and determine priority areas for action
    a. Estimate number of families affected
    b. Estimate economic losses
    c. Estimate recovery costs
    d. Establish priority zones

E. Explore potential mitigation opportunities

1. Identify avilable immediate mitigation possibilities, e.g.:
    a. Retrofit of existing buildings
    b. Replacement of vulnerable buildings
    c. Shifting urban developent patterns
    d. Strengthening new structures

2. Identify non-structural mitigation strategies:
    a. Insurance
    b. Alternative siting
    c. Alternative housing aproaches (reduction of building heights' etc.)

II. Develop Proposals for a Comrehensive Mitigation Program

A. Develop policies

B. Develop statement of objectives

C. Develop task assignments

D. Identify priority areas (by hazard and location)

E. Develop proposals for specific mitigation program

F. Develop a pulic awareness program

G. Develop a preliminary budget

TABLE III C: OUTLINE FOR AN AGICULTURAL VULNERABILITY ASSESSMENT

I. Steps in Planning a Program

A. Establish a planning team and designate and oversight authority (usually Ministry of Agriculture)

B. Select personnel

1. Professional staff:
   a. Agricultural extensionist
   b. Soils specialist
   c. Agricultural economist
   d. Irrigation specialist/agricultural engineer

2. Semi-professional staff:
   a. Cartograper
   b. Draftsman

3. Clerical staff:
   a. Secretary
   b. Clerk-typist

C. Collect data

1. Risk mapping
   a. Define threats
      1) drought
      2) flood
         - runoff flooding
         - ponding and standing water
         - breached flood barriers
      3) wind damage
      4) mudslides
      5) erosion

   b. Identify threatened areas (regions, zones)

2. Vulnerability mapping
   a. Identify crops at risk
   b. Map areas where vulnerable crops are grown

3. Collect environmnt data
   a. Climatic data
   b. Rainfall
   c. Soil typs
   d. Topographic data
   e. Hydrologic data

4. Collect agricultural data (by crop)
    a. Crop varieties in use
    b. Growing season(s)
    c. Land requirements
        1) soils
        2) land structures (terraces' etc.)
        3) drainage needs
        4) irrigation needs
        5) ph-requirements
    d. Cropping patterns
    e. Density ratios
    f. Natural alternatives

5. Identify secondary threats resulting from a disaster
    a. Loss of draught animals
    b. Breakdown of irrigation system
    c. Contamination of soil and/or wells
    d. Loss of water sources (dry wells, etc.)

6. Predict losses and determine priority areas for action
    a. Estimate number of farmers affected
    b. Estimate economic losses
    c. Estimate recovery costs
    d. Establish priority zones

D. Explore mitigation alternatives

1. Identify traditional responses
    a. Crop diversification
    b. Growing quick-maturing varieties to reduce exposure to threat
    c. Growing disaster resistant varieties
    d. Growing "famine food"

2. Identify other responses:
    a. Crop diversification
    b. Alternative varieties
    c. Alternative crops
    d. Alternative cropping patterns
    e. Improved storage/silage
    f. Structural protection for farms
        1) for flooding
            - raised platforms
            - terraces
            - levees
            - contouring
            - improved drainage
            - improved irrigation
        2) for storm surge and tsunami run-up zones
            - seawall
            - dikes
            - raised roads
        3) for wind storms
            - natural windbreaks (trees, shrubs)
            - contours
    g. Watershed management
        1) range management

2) forestation
3) channelization
4) diversions
5) dams
6) ponding

E. Develop a comprehensive program

1. Program elements

2. Plan requirement
   a. Description, in sequence, of actions to be taken before, during, after disaster
   b. Job/task descriptions
   c. Lines of authority, and communications and reporting procedures
   d. Specifications for allocation of funds, equipment, transport and materials
   e. Procedures for establishing that an emergency exists

3. Elements of a typical mitigation plan
   a. Statement of policy
   b. Statement of objectives
   c. Task assignments (with table of organization, job specifications)
   d. Identification of priority areas (by threat and crop)
   e. Operational plans with checklists and task sequences
      1) pulic awareness
      2) extension
      3) resource allocation
      4) incentives
      5) financial assistance
      6) insurance

III. Helpful Tools for Pre-Disaster Planing

A. Remote sensing and aerial photography (by month)
B. Computer "thematic" maps
C. Animal census
D. Economic loss estimates
E. Others

III. C. DISASTER PREPAREDNESS

2. TRAINING

Some specific issues related to training in earthquake risk stocktaking were discussed in an earlier section. This chapter will deal with some general issues.

Training is a critical component of disaster preparedess. It has two purposes: to orientate, familiarize and improve the skills of the emergency management team; and to test and validate the workability of emergency plans and their various elements. Training should be viewed as a continuing process; as plans are revised, training routines must be modified and adapted to the new plans. The performance of various teams during drills, simulations and exercises must be carefully scrutinized to determine problem and identity areas where aditional training can overcome specific weaknesses. The training may point to weakesses in the plan itself and indicate elements that need to be revised, simplified or streamlined.

A wide variety of training systems are now in use throughout the world. A recent UNDRO pulication lists over 100 organizations that provide emergency management training or education. A variety of teaching techniques and training media have been developed to improve public officials' ability to successfully manage a variety of contingencies. These include self-teaching models and "distance" edcation courses, traditional classroom training and lectures' field drills and exercises, scenario-based simulations, computer-interactive training, and sophisticated gaming exercises.

Personnel at different levels of the emergency response system require different typs of training. For examle, people likely to carry out search and rescue functions need field exercises to familiarize them with equipment and various rescue techniques, while senior emergency management officials in Civil Defense and key local or national government positions require training in management techniques designed to improve their ability to make decisions under crisis conditions. Therefore, a full range of training requirements should be identified and appropriate training methods be matched to needs.

As a result of the major emergencies of this decade (the 1983 Colombian earthquake, the Bhophal industrial accident, the 1985 Mexico City earthquake, the Chernobyl nuclear disasterin 1986, the 1988 floods in Khartoum and Bagladesh, and the 1988 Armenian earthquake, etc.), the international community is in the process of reevaluating and reassessing many of the approaches commonly used for managing various typs of emergencies. It is important that Civil Defense enter into this international dialogue, contributing the lessons learned from recent Soviet exprience and helping tailor the international training program that are in the process of development and/or revision. By participating in this dialogue, opportunities may arise for Soviet Civil Defense personnel to participate in the development of improved training methods.

In this connection we are satisfied to learn that the Civil Defence together with the authorities concerned of the USSR and jointly with UNDRO now plan an international training seminar on earthquake management in Moscow in September 1991.

The Civil Defence should present the lessons learned in managing the catastrophic Spitak earthquake for discussion. Moreover, authorities of international status should be given an opportunity to regularly exchange their experience. This would contribute to saving the cities and the cultural heritage, industries and agnicultural regions and reduce casualties and untold misery as well as enormous consequential losses to the national economy.

IV. CONCLUDING REMARKS

ANALYSIS OF POSSIBLE CORRECTIVE GENERAL MEASURES

During the course of the mission, it was possible for the team to identify a number of proposals under consideration to reduce vulnerability and to improve emrgency management capabilities. The following are some observations by the team on the various proposals. They have been classified under the general headings of "Vulnerability Reduction" and "Disaster Preparedness and Emergency Management".

It is, however, stressed that the following pages do not contain a comprehensive review or discussion of the recommendations of the team. Therefore it is suggested that all chapters of this report are consulted in this connection, in particular as regards detailed recommendations related to the many parameters which determine exposure.

A. EARTHQUAKE VULNERABILITY REDUCTION

1. Revsion of Building Codes and Standards

As mentioned previously, there are numerous proposals to revise building codes. Unfortutely, it was impossible for the team to analyze the existing codes; however, a review of reports by the assessment missions reveals only a few major shortcomings. An assessment mission of the US National Academy of Sciences after the 1988 earthquake reported that "Soviet engineers were designing buildings for seismic forces in the affected area; however, the Soviet Code does not have material requirements like US codes providing for ductile performance by important members. Therefore, modern engineered buildings exhibited generally poor performance with many collapsed buildings."

Some revisions of the building code may be necessary, but they will have little impact on overall performance until adequate quality control is attained and the basic detailing of construction is improved as discussed more in detail in the respective section.

2. Revision of Seismic Zonation

Since the earthquake, a number of scientists have suggested that the maximum expected earthquakes in the seismic regions of Arenia were underestimated and have suggested that the seismic zonation be increased. The apparent reason for the upward revision is that the damages sustained in Leninakan and Spitak were a result of a much larger earthquake than had been expected. It is the belief of the members of the mission, however, that the earthquake was not unusually large and that the widespread failure of modern buildings was due to more fundamental deficiencies such as siting problems (especially siting soft high-rise buildings on soft soils), poor matching of building types to the site, poor-quality building materials, lack of attention to critical building details during design and construction, and lack of quality control throughout the building process.

3. Retrofitting of Extisting Buildings

There is understandable concern about the safety of other structures similar to those that failed in the recent earthquake. Numerous building officials have proposed a widespread program to reinforce existing buildings, and design studies are underway to determine suitable methods, especially for reinforcing the nine-story precast concrete frame buildings similar to those that collapsed in Leninakan.

While it is important that high-occupancy buildings be thoroughly assessed and that buildings which are unsafe be replaced as soon as practical, it should be remembered that the return poriod of

earthquakes is sufficiently long that many existing buildings will be replaced in the normal process of attrition long before the next earthquake strikes. Therefore, the team recommends that more emphasis be placed on building new structures safely. Only those buildings which meet the criteria discussed in Section III - structures that are of high priority due to occupancy levels, or those that house key administrative or economic facilities - should be retrofitted or strengthened.

B. Distaster Preparedness and Emergency Management

1. Improvement of Communications

Numerous observers have reported the need to improve post-disaster communications capabilities Several elements need attention. The first is the development of a comprehensive communications concept. The commmuications systems emloyed in the aftermath of the recent earthquake were those of the military. For the most part, the equipment was used by the major decision-makers and their staff and was reportedly tied up in passing situational informtion from the disaster site to higher authorities. In the affected areas, there was very little ability to communicate with, or coordinate, the various emergency services. Communication stopped at the level of the municipal emergency management center; there was no effective communication with the various field elements. Perhaps one of the most serious indicators of this problem was the fact that foreign search and rescue units set up their own coordination and communications center. Military radios were limited to military frequencies, and military commanders were reluctant to pass their equipment into the hands of civilians; foreign teams were unable to communicate with the central emergency management authorities due to incompatibility between these frequencies on their radios and those of Civil Defense.

Communications are vital in any emergency. Modern hand-held, battery-operated radios are far less expensive than tents and other types of assistance provided to disaster victims. If low-powered radios are seen in this light, they can be mass-produced, stockpiled and, in an emergency, distributed to the various emergency services and spontaneous search and rescue teams.

By rethinking the role of communications, a communications net can be properly designed and configured to meet a variety of emergency scenarios.

The second communications problem that must be adressed is radio communications between the disaster area and the principal support areas outside the aeffected zone. One of the major problems faced in all disasters is not just how to send messages but what to send. Proper radio procedures and priority assignments for different types of messages must be clearly set out, and personnel in various sections of the emergency response effort should be trained in what to communicate and how to structure and prioritize the various messages.

Since an important inflow of emergency assistance to the victims of the Spitak earthquake came from abroad, mobilized by UNDRO, efforts should concentrate on the creation of reliable communication to international emergency coordination centres. They are a suitable basis for information systems for the international community. In this respect one should consider the aquisition of communication facilities via satellite. (It is symptomatic that foreign correspondents who came to visit Spitak and Leninakan after the earthquake often took a plane to Moscow in order to be certain of telephoning their report abroad.)

2. Revision of Disaster Scenarios

Within Civil Defense, efforts are underway to revise the various emergency scenarios that face the Repulic.

Once the various scenarios have been revised, there is an opportunity to develop training programs based on these scenarios. An important element to consider is development of "situational awareness" training. Situational awareness is a technique in which emergency managers are shown typical problem areas, the decisions that are made, the causes and effects of each decision, and how poor or incorrect

decisions compound problems down the line. By learning to identify "decision chains", emergency managers can identify various situations that are unfolding and can learn how to take appropriate actions to intervene and change the course of events.

It is also suggested that the training activities should include stock-taking and vulnerability assessment exercises as described in other sections.

3. Proposed Revisions to Existing Emergency Plans

After discussions with Civil Defense authorities, the team recomends that two aspects of emergency planning be considered further: decentralization and development of response doctrines.

Decentralization of emergency authority is currently being discussed and limited planning is underway. The team believes this is a move in the right direction and encourages Civil Defense to explore even more ways in which decision-making can be shifted to local communities. This entails a rethinking of the Civil Defense concept. Instead of having a highly centralized national control system, a decentralized system based on self-activating and self-supporting units, augmented and complemented by outside resources, should be encouraged.

The development of new doctrines based on the proposed decentralized system should also be explored. The most important elements of these doctrines are: responses based on the usual behavior of survivors and organizations within the disaster area. For example, search and rescue should be tailored to local popular responses. Ninety-nine percent of all people rescued in the aftermath of natural disasters are rescued by friends, neighbors and other survivors. Support of this response is likely to yield far higher numbers of rescues than forming, training and equipping of elite search and rescue teams to be sent to the site. Likewise, shelter strategies, plans to support survivors on and near the site of collapsed buildings, evacuation procedures based on evacuation behavior, etc., could all improve overall response and increase the number of survivors.

Another critical area that must be reviewed is emergency medical doctrine, especially postoperative care for persons who have been rescued. The number of people who died after they were brought to the hospital, especially those who received surgical care, was disproportionately high. This indicates a need to revise postoperative and intensive care procedures.

4. Post-Disaster Assessments

A number of Civil Defense and public officials have indicated that the initial disaster assessment was inadequate and did not provide sufficient informtion for emergency decision-making.

Assessment is critical in the early stages of an emergency. With proper planning, assessment procedures can be adopted that will provide sufficient information to initiate emergency actions and address the most critical needs. A number of excellent disaster assessment guides exist that could be adapted. In adition, several software programs are currently under development utilizing geograpic informtion system (GIS) technology that could easily be aplied to the Armenian situation. An early decision should be taken so that data from the inventory of the existing building stock (described in Chapter III) can be incorporated in the overall design of the system.

5. Mandatory State Disaster Insurance

A number of officials have proposed that persons living in high-risk areas should be required to purchase earthquake insurance. In this way, a cash pool could be created to help defray reconstruction costs in the aftermath of a future disaster.

The team feels that mandatory earthquake insurance at this time would be inapropriate. Since families have no meaningful control over the quality of the buildings in which they live and since the

authorities permitted the buildings to be constructed in an unsafe manner, the government should bear responsibility for improving or replacing the structures. To ask the occuppants to pay for poor buildings because the governmental authorities failed to institute proper quality control seems to be a case of penalizing the victims - not rectifying or addressing the cause of the problem. Only if building occupants have a voice in the construction of buildings and quality control should mandatory insurance be considered.

6. Adoption of New Legislation/Law to Govern Emergency Situations

Various Civil Defense officers have metioned the need for new legislation and laws to activate emergency measures and to govern emergency services in the aftermath of a major disaster. Preparation of this legislation should follow the reorganization of Civil Defense and the development of doctrines. In order to support these new initiatives, "enabling" legislation, which defines rules and responsibilities of repulic and municipal officials, is vital. Numerous models from other countries can be analyzed and, where apropriate, adapted to the Soviet system now emerging.

7. Expansion of the Role of Firefighters

It has been proposed that the role of firefighters in each threatened community be expanded, especially in search and rescue, first aid, emergency medical assistance, and several other vital areas. In principle, these measures should be supported. Providing firefighters with improved rescue equipment has great potential for improving response to more complicated rescues. However, attention also needs to be given to defining appropriate roles for firefighters in various types of emergencies and developing post-emergency routines whereby their expanded assets are committed according to a prescribed plan. (One of the major problems which is in general encountered when inadequately prepared and trained firefighting units are made the focal point of on-site response is that they usually stop at the first collapsed building site they encounter and become tied up at that building. If they have broad search and rescue responsibilities, their assets must be committed on the basis of established priorities, not simply the first site that they reach.)

8. Converting Civil Defence to a Civilian Agency (and Changing the Name)

Serious discussions appear to be underway about taking Civil Defense out of the Ministry of Defense and reestablishing it as a civilian organization. Following that, it has been suggested that the name of the organization be changed to reflect the organizations broadest responsibilities and to stress its civil orientation, for instance, Civil Protection Agency.

Historically in the Soviet Union as well as elsewhere, Civil Defense has been linked to preparedness for war and, for this reason, most civil defense agencies have been located within military estalishments. Today, most countries are abandoning this model, primarily because military agencies are not configured to meet civil disaster needs. Separating Civil Defense would have several immediate benefits:

- a wider variety of civilian agencies would be able to participate in disaster preparedess planning.

- emergency plans could be more closely tailored and configured to civilian need.

- a greater number of international contacts can be made, thereby opening new areas for technical exchange, training and information-sharing.

ANNEX A.

A REPORT OF THE CIVIL DEFENCE SERVICE OF THE ARMENIAN SSR.

INFORMATION MATERIAL ON THE ASSESSMENT OF THE READINESS OF THE COMMAND ORGANS, FORCES AND MEANS OF THE ARMENIAN SSR TO MITIGATE THE CONSEQUENCES OF NATURAL AND INDUSTRIAL CATASTROPHES

The territory of the Republic is 29.900 square kilometres. The Republic has 37 rural areas and 27 cities, out of which four are large with populations of 150,000 to more than one million

The density of the population of the Republic, the average density, is 115 persons per square kilometre. Maximum density is located in the ARARAT valley, where there are more than 400 people per square kilometre.

In the Republic there are 3.5 million people, of which 67% live in the cities.

The most developed industries in the Republic are:

* Machine building.
* Power.
* Electro-technical.
* Radiotechnical.
* Building Plant.
* Chemical.
* Metallurgy.

On the territory of the Republic there are potentially hazardous industries, such as the Armenian Nuclear Power Station, which has been closed since April 1989. 29 chemical plants which are also considered dangerous, and also a number of plants which are considered dangerous from the point of view of fire or explosion. Particularly hazardous are such productions associated with chlorine and ammonia which are located in the plant NAIRIT and the production complex POLIVINILACETAT, are located in Erevan. The total number of people which could be affected by disaster in a chemical plant is assessed at about 52,000, out of which could be affected very seriously,or killed, are 34,000 people.

Natural disasters considered most frequent in Armenia are:

* Earthquakes.
* Mudflows
* Floods.
* Landslides.
* Slope collapse.

In the Republic all the territory is considered seismo-active. The areas of such cities as KIROVAKAN, ALAVERDI and KOLAGARAN are also considered dangerous from the threat of mudflows.

Areas of valleys and rivers such as ARAKS, AHURIAN, DEBET. In these areas the valleys are threatened by floods on human settlements located in the regions of OKTEMBERIAN, MASIS, ARARAT, A CKOM and TYMA C O . The total area which can be flooded is assessed at approximately 60 square kilometers, wirth a population of 45,000 people.

Of substantial danger to the people is the possibility of the failure of the dams in APARAN, ZOVASHEN, AHURIN, ARPILECH an on other reservoirs. In the zone inundated in that case could be more than 150 human settlements with a total population of more than 300,000 people.

REMARK: The editor could not verify the correctness of all names which were in part wrongly transliterated.

II. ORGANS GOVERNING CIVIL DEFENCE

Civil Defence covers all the territory of the Republic based on the principle of types of industry and locations.

The Chief of Civil Defence for the Republic is the Chairman of the Council of Ministers of Armenia.

Its operational base is the Headquarters of Civil Defence of the Republic in Erevan. In the cities and regions Chiefs of Civil Defence are the Chairman of the Executive Committee of either the cities or the settlements. In ministries, committees and institutes and in industry, chiefs of Civil Defence are the Heads of the various bodies. For all activities on Civil Defence there is a related department headed by a fulltime worker. In the Republic there are also permanent emergency commissions headed by first deputies of the respective plants and production complexes. In the commissions, chiefs of the ministries, committees and organisations are iucluded.

Working bodies of the commissions are created from the Headquarters of Civil Defence.

Emergency Commissions work to implement emergency plans prepared by Civil Defence. When the rescue work is carried out, this is coordinated with staff of military commands.

After the Spitak earthquake of 7th. December, 1988, the following drawbacks and shortages can he established:

(a) Absence of reliable communications, and limitations of the communications service of the Republic as far as capacities of the Republic are concerned to develop new channels of communication.

(b) Shock and death of chiefs of local civil defence units which made ungovernable some forces of civil defence in the disaster area.

(c) Plans of civil defence have not corresponded with, or taken into consideration, the extent of the catastrophe, therefore the scope and extent of the civil defence operations required additional capacity, efforts and means to meet all the immediate requirements.

(d) Inappropriate levels of organisation and carrying out reconnaissance resulted in the early stage, in imprecise assessment of the scale of the catastrophe, especially in the settlements, and in rural settlements.

(e) Inappropriate organisation of the services of public order and security, and reglation of traffic on the programme of evacuation and on the programme of the entry of the services.

(f) Isolation of the regions of the disaster area was not made in time, and the organisation of the services was ineffective later.

(g) Shortages in the coordination of the main forces and clear formulation of tasks to services and to overseas groups in the disaster area.

(h) Organs of government, headquarters and management at all levels had difficulties because of insufficient material support. Absence of well equipped stations, mobile means of communications, means of automatization for taking assessment, and processing of information, and shortage in reserve of mobile radio stations and other means of communication.

(j) In the conditions created by the Commission of the Politburo the operational groups of Ministry of Defence, the Headquarters of civil Defence, Headquarters from the Republics of the USSR and Institutes have not found, or have not been fully incorporated in the system of management.

All the difficulties and shortages were typical to the first stage of the mitigation of the consequences of the management of the disaster.

All the above shortoomings were in the first stage of the operations (7 - 10 December).

III. FORCES AND MEANS OF CIVIL DEFENCE.

The forces and means of Civil Defence are non-military units created on the basis of territorial and industrial complexes and organisations which are sub-divided on the basis of their tasks.

* Rescue.

* Medical.

* Firefighting.

* Police and Public security.

* Automobile.

* Repair services etc.

and parts and units of Civil Defence.

The structure and number of units are determined by relating chiefs depending on the needs of functional and territorial tasks.

The plans of civil defence were proposing the creation of special groups and forces and means of civil defence to meet the requirements of the situation of particular structures, or in some regions of the republic.

The governmental commission involved in meeting the requirements of the local authorities, cities and regions sent forces and the means to provide assistance to the population in the disaster area. By the same decision all non-military units of civil defence were made available and ready to intervene in the operation, and also the units of the Soviet army, militia, police and internal forces.

By the end of 7th December all the groups of forces included

* an integral group of civil defence, an integral group of the forces of mechanisation of the republic.

* an integral group of civil defence and an integral group of the forces of mechanisation of the city of Erevan.

* territorial units of civil defence of the fourteen rural areas of the disaster.

* special units of civil defence (i.e. medical, firefighting, communication, information, police and public security, commerce and feeding, roads (communal, technical) and material technical services.

Total number of personnel 11,000 anud more than 1200 mechanised units.

In order to carry out rescue work there was also mobilized one more unit of Civil Defence of the Soviet Army, and of the Ministry of Internal Affairs, and also forces of the construction industries worth a total of 14,000 personnel and 710 mechanised units. Next day, 8 December, the forces of this group were increased, and by the end of December the total number of personnel involved in rescue and mitigation efforts were 61,500 personnel and about 9,000 mechanised units. A chronology of rescuing people was carried out.

In spite of the fact that the forces of the emergency operation were increased regularly on the basis of every day extrication of the people rescued from the debris in the first days, after that it was drastically decreased, and that was becauss of the inability of a person to survive in the conditions of the disaster and debris.

By 11 December there were extricated 4419 people, out of which were 1757 alive. From 12 - 18 December 8107 extricated and alive 150. From 19 - 25 December 418 extricated of which only 1 was alive.

An analysis of the rescue operations highlighted the following shortages:-

* the quality of management of the forces and the means during the first days was unsatisfactory because the headquarters had not had sufficient information on the spot. There were no communications with rescue units and the service of regulation and cordoning had not been enforced.

* traffic difficulties on the roads were preventiag timely entry into the area of forces and services.

* the complexity of the organisation of the forces arriving from all over the country and from other states was evident and that was because one was not informed in advance of the time of arrival, the mechanical capacities and possibilities.

* As a follow-up of this the planning measures were carried out upon the arrival of these groups and therefore in a rush and decisions of the questions of their allocation were taken in a hurry and without appropriate analysis.

* Engineering techniques and rescue equipment which were on the non-military units definitely have not matched up to the requirements of the tasks, and that is one of the major lessons learned from the earthquake which resulted from a deficit in cranes for heavy loads, in rescue equipment and small tools.

If all these requirements had been met the number of people extricated and alive could have heen much more.

IV. PROVISION OF THE POPULATION AND THE FORCES DURING THE OPERATION

During the operations from 7 to 8 Decenber about 130 medical brigades were created and sent into the disaster area. By the end of 8 December in the cities of Leninakan and Spitak were then 180 medical brigades including specialist and medical support from different regions of the country,

250 top level specialists from the medical military services arrived in the disaster areas on 8 December. In Erevan additiounal capacities for hospitals for 10,000 beds were developed by 1800 hours on 7 December. During the first 24 hours medical help was provided to 4700 injured. They were evacuated to hospitals in Erevan and 6 rural regions.

By 9 December in the hospitals of Erevan were 5500 people evacuated from the area. For medical evacuation there were used up to 600 ambulances and other mobile transport units, also helicopters and planes of civil and military aviation totalling 472 flights.

A large number of crush syndrome victims were hospitalized in three medical centres which had a severe shortage of artificial kidney machines. These circumstances were a major reason to evacuate other victims to the central hospitals of Moscow. Additionally in the area of the earthquake several hospitals were established with a total of 1150 beds. In addition, with the assistance of foreign countries, 10 more mobile hospitals were established.

To support the population during the disaster 144 mobile feeding units were developed. Distribution of some essential foods was free to the population from 7 - 31 December. Meat production, canned foods, totalled 1890 tonnes. Other food products about 3.900 tonnes. To provide bread the bakeries i Erevan, Dillijan, Rasdan, Ahovjan, Octemberian were used.

From 7 December 1988 to 1 February 1989 essential support was provided by vehicles and by logistical support totalling about 74,500 vehicle days. To evacuate the population to other areas of the country about 80 passenger trains which transported 79,750 people.

As a result of the earthquake there was total destruction of 250 km of water pipelines; 342 km of the water distribution network and 6 water purifying stations. The water distribution was cut to the cities of Leninakan, Spitak, Akurian and partially to Kirovakan and Stepanovan. Water distribution was restored in 2 - 5 days. All measures to purify the water were taken. There were no cases of people suffering from the inappropriate quality of the water. During these 2 - 5 days the water was distributed by 210 tankers for free distribution of water to the area, also ahout 600,000 bottles of mineral water.

As a result of the earthquake ahout 514,000 people were made homeless and provision of shelters were organised in three major directions:

(1) For population evacuated (120,000): to sanatoria, pensions, hotels and schools.

(2) For population staying in the area were developed 55,000 tents for 120,000 people, and 19,220 wagons for a total of 77,000 people.

(3) The remainder were accommodated with relatives and in the houses of the private sector.

The means of mass information were the distribution of notes, prohibition of mass social events and measures to inform and repeat the rules of conduct of the population in the case of after shocks.

V. PERSPECTIVES FOR IMPROVING CIVIL DEFENCE

A decision has been taken to formulate by the end of the year a state system on emergency operations which could include the consequence of industrial and natural disasters. This system could include training of forces and personnel to react in the emergencies, carrying out measures to mitigate suffering and loss, promote effective protection of the population and the organisation of rescue work and urgent activities.

These units have to have the necessary support, personnel, forces and means to act and to react in emergency situations. The task which would be put to such units would be first of all prevention of the creation of an emergency situation and the attenuation of damage. Effective protection of the

population from the consequences of natural catastrophes and disaster. Quick intervention to carry out rescue operations and other necessary work.

The structurs of the organs of such units is to he constantly reviewed and improved. Units of civil defence are to move to a new stage of their activities, and to increase their readiness in case of disaster situations.

In Armenia there is to be created operational rescue services which are to be staffed with highly professional specialists and equipped with the rescue equipment and means. The structure and proposals are attached.

Development of new scientific models of new emergency situations and on this basis creation of a related programme to prevent and to prepare and to be prepared for new catastrophes and natural disasters. To reduce consequences of possible events, carry out work to assess requirements in forces and the means necessary requirements to meet the extent of the damage and to reduce the possible damage.

The system of communications and information is to be improved through the creation of a centralised information and digital processing system and network which would automatically take into consideration and process information, processing analysis and stocktaking relating to emergency situations.

More qualitative, and of better quality, organisation of new training seminars on management and actions in emergency situations, training of the population to the rules to be followed in such conditions.

Measures which are considered a first priority to increase the readiness of the organs of management and forces to react in emergency situations:

(1) The points of the management are to be equipped by means of commuunication, imformation, and data processing, also mobile means on the basis of a network of personal computers.

(2) Creation of professional rescue units and such units are to be equipped hy necessary means and hardware.

(3) Establish a list of possible emergency situations on the territory of the republic.

(4) Prepare flexible plans of actions and interrelation of forces and means when the management of such an emergency situation is being carried out.

(5) Training of the personnel of the management bodies, forces and means are also to be carried out to ensure appropriate readiness in such appropriate situations.

APPENDIX.

LIST OF ENGINEERING AND ROADBUILDING TECHNIQUES AND EQUIPMENT AVAILABLE TO CIVIL DEFENCE

(1) Cranes of capacity of 7t. 10/16t. more than 16 t.

(2) Excavators with a capacity from O.6 - 1 m3.

(3) Excavators with a capacity from 0.25 - 0.6 m3.

(4) Bulldozers on a base of tractors T100 and T130.

(5) Scrapers with a capacity 8 - 10 m3.

(6) Tractors T100 and T130.

(7) Loader with a capacity of 1 - 3 m3.

(8) Trailers to transport heavy engineering equipment.

(9) Lorry hopper with a carrying capacity from 5 - 12 t.

(10) Autograders.

(11) Trenching equipment.

(12) Well horing equipment with a possibility of drilling to 50m.

(13) Diesel compressor sets.

(14) Well drilling equipment.

(15) Compactors.

(16) Rigs for boring wells.

(17) Repair mobile unit.

(18) Water mains repair moile units and machines and cars.

(19) Cars for mobile units of heat distribution network.

(20) Mobile vehicle repair units.

(21) Water motor drilling equipment.

(22) Compressors and drills.

(23) Gas welding apparatus.

(24) Equipment for vehicle repair.

(25) Mobile generators 8 - 12 kw.

(26) Trailers.

(27) Cutters of reinforcements on the basis of kerosene.

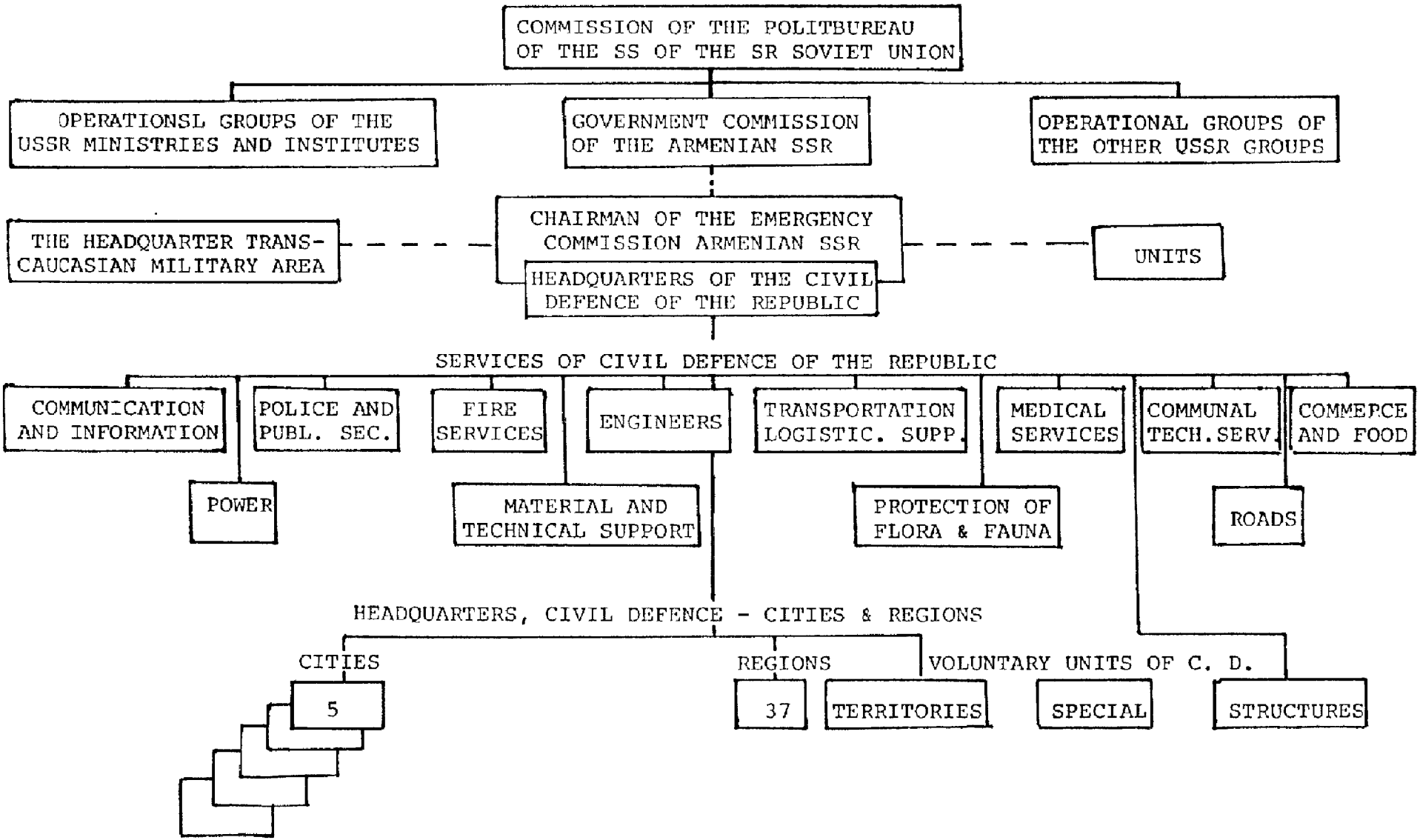
(28) Fire watertanks.

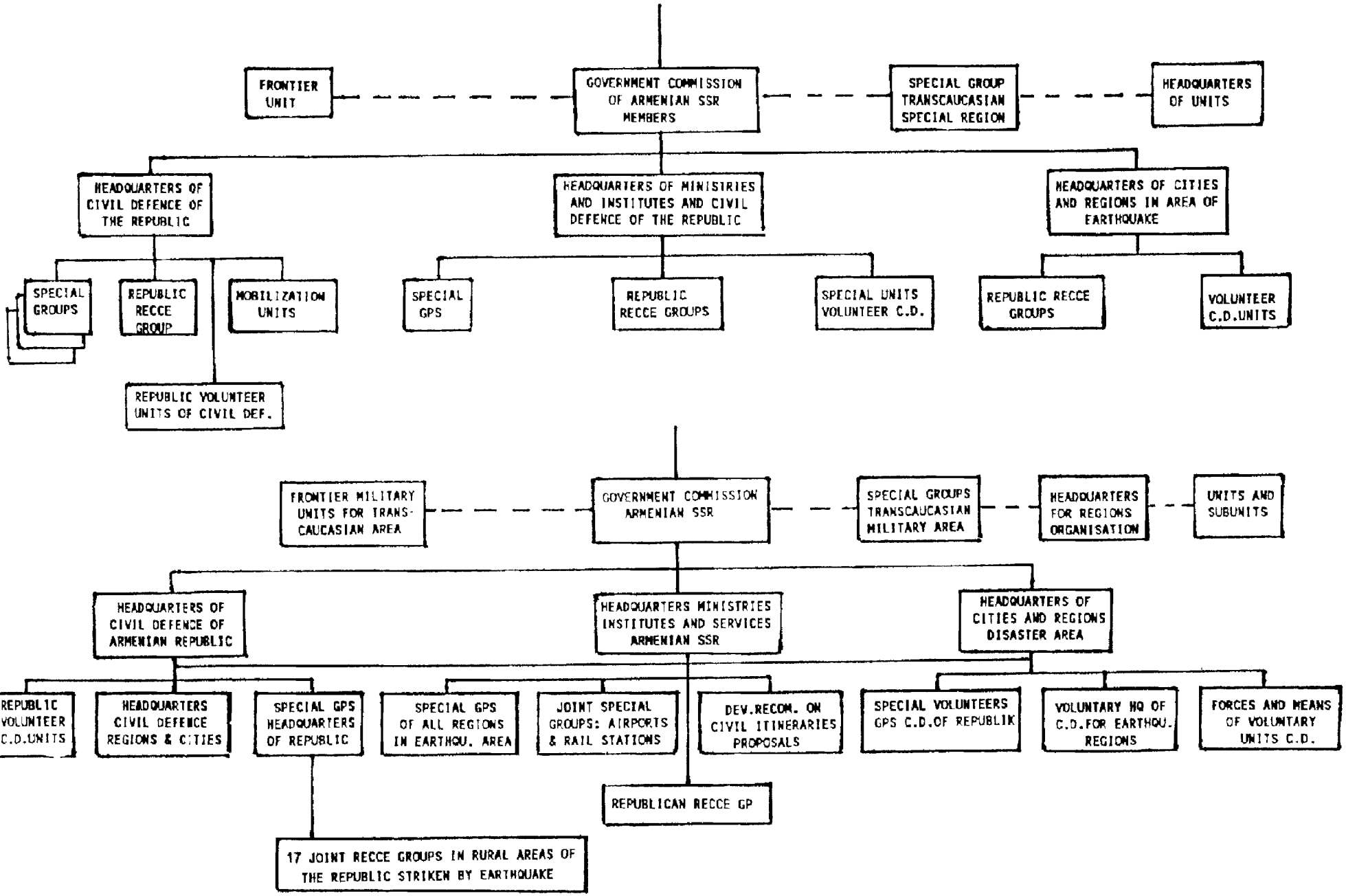
(29) Motor pumps with a capacity of 600 litres/hour.

(30) Pumps for firefighting.

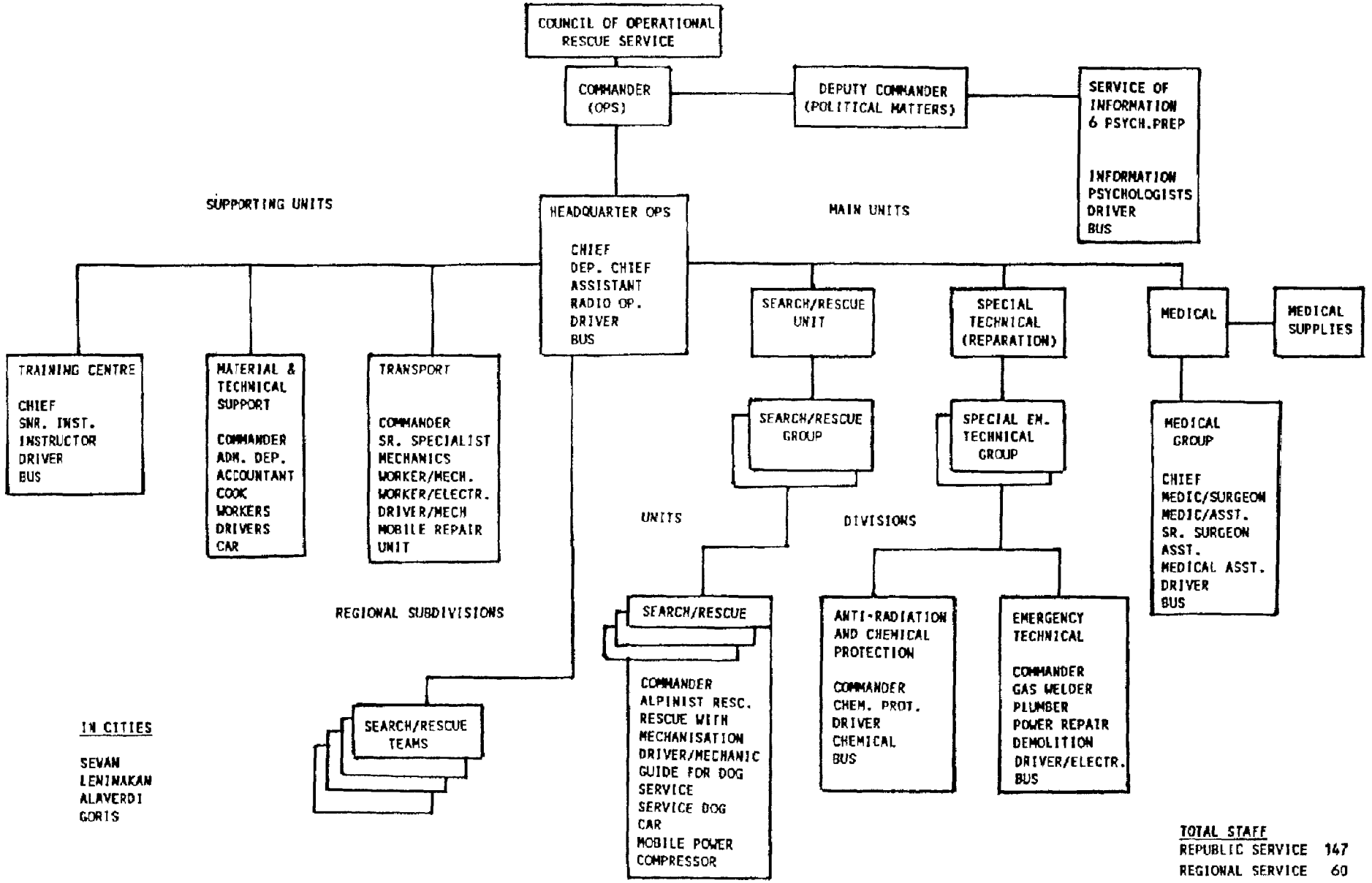
(31) Mobile filtration plant with a capacity 7.5m3/hour.

ORGANIZATION CHART OF MANAGING THE FORCES AND THE MEANS AT THE RECOVERY OF THE CONSEQUENCES OF THE ARMENIAN EARTHQUAKE




FRONTIER UNIT
GOVERNMENT COMMISSION OF ARMENIAN SSR MEMBERS
SPECIAL GROUP TRANSCAUCASIAN SPECIAL REGION
HEADQUARTERS OF UNITS
HEADQUARTERS OF CIVIL DEFENCE OF THE REPUBLIC
HEADQUARTERS OF MINISTRIES AND INSTITUTES AND CIVIL DEFENCE OF THE REPUBLIC
HEADQUARTERS OF CITIES AND REGIONS IN AREA OF EARTHQUAKE
SPECIAL GROUPS
REPUBLIC RECCE GROUP
MOBILIZATION UNITS
SPECIAL GPS
REPUBLIC RECCE GROUPS
SPECIAL UNITS VOLUNTEER C.D.
REPUBLIC RECCE GROUPS
VOLUNTEER C.D.UNITS
REPUBLIC VOLUNTEER UNITS OF CIVIL DEF.
FRONTIER MILITARY UNITS FOR TRANS-CAUCASIAN AREA
GOVERNMENT COMMISSION ARMENIAN SSR
SPECIAL GROUPS TRANSCAUCASIAN MILITARY AREA
HEADQUARTERS FOR REGIONS ORGANISATION
UNITS AND SUBUNITS
HEADQUARTERS OF CIVIL DEFENCE OF ARMENIAN REPUBLIC
HEADQUARTERS MINISTRIES INSTITUTES AND SERVICES ARMENIAN SSR
HEADQUARTERS OF CITIES AND REGIONS DISASTER AREA
REPUBLIC VOLUNTEER C.D.UNITS
HEADQUARTERS CIVIL DEFENCE REGIONS & CITIES
SPECIAL GPS HEADQUARTERS OF REPUBLIC
SPECIAL GPS OF ALL REGIONS IN EARTHQU. AREA
JOINT SPECIAL GROUPS: AIRPORTS & RAIL STATIONS
DEV.RECOM. ON CIVIL ITINERARIES PROPOSALS
SPECIAL VOLUNTEERS GPS C.D.OF REPUBLIK
VOLUNTARY HQ OF C.D.FOR EARTHQU. REGIONS
FORCES AND MEANS OF VOLUNTARY UNITS C.D.
REPUBLICAN RECCE GP
17 JOINT RECCE GROUPS IN RURAL AREAS OF THE REPUBLIC STRIKEN BY EARTHQUAKE

SCHEME OF ORGANISATION OF THE OPERATIONAL RESCUE SERVICES, ARMENIA



ANNEX B

BIODATA OF THE MEMBERS OF THE MISSION

Eric Alley, O.B.E. is currently the President of the British Institute of Civil Defense, and has been a consultant to UNDRO and the International Civil Defense Organisation for many years. He has been professionally engaged in civil defense and emergency planning for 36 years, and he has served in five major local authorities in the United Kingdom. He spent his last three years as Civil Defense Adviser to the Home Office. He retired from this post in 1987 and was awarded the OBE for his services to civil defense.

He is a Fellow of the Institute of Civil Defense and was awarded the Silver Medal in 1966.

Since 1969, Mr. Alley has planned and directed a number of international courses for the International Civil Defense Organisation in Geneva, and has served on a number of overseas missions to Lebanon, Saudi Arabia, Nigeria, and Venezuela.

Frederick C. Cuny is a USA registered planner and is founder and Chairman of INTERTECT, a professional emergency management consulting firm based in Dallas, Texas. Mr. Cuny's twenty years of experience in this field reflect a wide range of natural disasters and refugee emergency activities worldwide including pre-disaster planning, policy development, post-disaster housing and emergency shelter programs, housing education, research and design for disaster resistance, urban and regional planning, post-disaster damage assessment, refugee camp planning and needs assessment, overall recovery strategies, comprehensive hazard mitigation strategies, evaluation and training.

His publications include "Disasters and Development" (Oxford University press); "Politics and Famine Relief" (in The Moral Nation: Humanitarism and U.S. Foreign Policy Today); and numerous INTERTECT articles, reports and training aids. He is also the author or editor of a number of training courses produced by the University of Wisconsin Disaster Management Center.

Dr. Bharat Singh graduated in Civil Engineering from Thoms College, Roorkee, India in 1945 and obtained D.I.C. and Ph.D. from Imperial College of Science and Technology, London University, in 1960. He also studied projects on a UNDP fellowship for four months in 1972. Dr. Singh specialized in Hydraulic and Water Resource Engineering, and gained field experience on various important projects in India for six years before joining the staff of the University of Roorkee in 1951. He rose to Vice Chancellorship of the University, retiring from that position in October 1986. Dr. Singh's research contributions have been in the field of alluvial channels, embankment dams and other hydraulic structures. He has published three standard text books and a number of research papers. He has been consultant on several important water resource projects in India and UNDP consultant to the Government of Iran for Lar Dam.

Mr. Nikolai Solomatine, born in Moscow, USSR, in 1937, holds an M.Sc. in hydraulic engineering and a Ph.D. in international economics. He worked for many years in 'Hydroproject' (Water Research and Development Institute) of Moscow responsible for feasibility studies and dam safety. He took an active part in design and construction of a tidal power plant on the Kola Peninsula, USSR. He has publications and patents of innovation on water utilization to his credit. For several years he worked as Assistant, and then as Deputy UNDP Resident Representative in African countries. Since 1984 he is a staff member of the Office of the United Nations Disaster Relief Co-ordinator (UNDRO).

Dr. Herbert Tiedemann was born in Munich, West Germany, in 1928. He holds an M.Sc. in mechanical engineering and a Ph. D. in physics. He worked for many years in Asia in projects concerning mechanical, electrical and civil engineering before joining the insurance community. He developed analytic risk assessment and optimization in the fields of engineering insurance, hydrology, climatology, seismology and volcanism. He was, and still is Member of the Management of the two largest Reinsurance Companies of the World, Munich Re, Munich, and Swiss Re, Zurich, respectively. Dr. H. Tiedemann is a member of the Seismological Society of America and of the Earthquake Engineering Research Institute, was a member of the European Seismological Commission and has been nominated as a representative of Switzerland to the Ad hoc Committee of Experts on Earthquake Research at the Council of Europe. He has been included in WHO'S WHO IN THE WORLD and in MEN OF ACHIEVEMENT edited by the International Biographical Centre, Cambridge, U.K.. Dr. H. Tiedemann is the author of a substantial number of papers and special publications in several fields of science. He has assisted UNDRO and various governments as senior adviser and leader of international teams of experts.

Dr. Masasuke Watari is Dr. of Agriculture, Tokyo University, Japan, and also holds a B. Sc. in Forestry Engineering of the same University. His activities and responsibilities can be summarized as follows:

Responsible for providing direction, technical guidance for a number of investigations and study on sabo work and techniques, landslide protection, erosion control and slope failure prevention works carried out by the Public Works Institute, Ministry of Construction, Government of Japan, as Director and Chief of Landslide Control Division, Erosion Control Division and Slope Failure Diovision, from 1953 to 1979.

Responsible for providing direction and technical guidance of many erosion control and landslide protection works in Japan engineered by Nippon Koei including:
- Investigation of landslide protection
- Design of landslide protection works
- Erosion control planning and prevention works
- Estimation of landslide areas,

as Director and Principal Geotechnical Engineer of Nippon Koei Co. Ltd., from 1979 to date.

Responsible for providing direction and technicaql guidance of erosion control and landslide protection works in foreign countries:
- Project landslide protection survey, Mauritius from 1979
- Landslide analysis and guidance at Tianshenquiao Hydroelectric Power Development Project, China, from 1986 to 1990
- Landslide protection work for Kulekhani Hydroelectric Project, Nepal, from 1975 to 1978
- Erosion control analysis and guidance after Guatemala earthquake, 1976
- Erosion control analysis for volcanic mudflow on Volcano Merapi, Indonesia, 1976.

Provided specific lectures on landslide control engineering as Lecturer of Kyoto University from 1979 to 1982, Lecturer of landslide control in the Faculty of Agriculture, Tokyo University of Agriculture and Technology from 1974 to 1979, President of Japan Landslide Society from 1988 to date.