NATO SCIENCE FOR PEACE PROGRAMME
Visit by NATO Consultant: Evaluation Report

PROJECT 974320: Seismic Risk in large Cities of Caucasus. Tools for Risk Management (SeRiCiCau)

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Vladislav Zaalishvili, IAMI, Russian Academy of Sciences, Vladikavkaz, Russia

Starting date of the project:	5 October 2000, effective 15 April 2001
Duration of project:	3 years, completion expected April 2004
Amount of award (BEF):	12,700,000 BEF (314,824 EUR)
Consultant visiting the project:	Dr Paul W. Burton
Dates of visit:	12-16 December 2003

Participants at the meetings 12-16 December 2003

1. Participants included from the project:
Professor Tamaz Chelidze, Director of IG, GAS, Tbilisi
[Dr. Zurab Javakhishvili, Head of Department of Regional Seismology IG, GAS: by phone prior to meeting]

with:
M Elashvili (Seismologist), Dept.Reg.Seismol., IG, GAS, Tbilisi
Tea Godoladze (Seismologist), Dept.Reg.Seismol., IG, GAS, Tbilisi
Tea Mumladze (Seismic Analyst), Dept.Reg.Seismol., IG, GAS, Tbilisi

Dr. Igor Timchenko (Head of Group), Institute of Structural Mechanics and Earthquake Engineering, ISMEE, GAS, Tbilisi

with:
Vakhlang Arabidze (Engineer), Inst.Struct.Mech.Earthq.Eng., ISMEE, GAS, Tbilisi
Sergo Gogmachadze (Geologist), Inst.Struct.Mech.Earthq.Eng., ISMEE, GAS, Tbilisi
George Lomidze (Programmer, GIS), Inst.Struct.Mech.Earthq.Eng., ISMEE, GAS, Tbilisi
Archil Odisharia (Geologist), Inst.Struct.Mech.Earthq.Eng., ISMEE, GAS, Tbilisi
Paata Rekvava (Engineer), Inst.Struct.Mech.Earthq.Eng., ISMEE, GAS, Tbilisi

2. NATO Consultant
Dr. Paul W. Burton, University of East Anglia, Norwich, UK

Evaluation summary:

The project scientific goal is estimation of seismic risk for selected sectors of large cities of the Caucasus; these sectors are: Sabail district of Baku; Saburtalo district of Tbilisi; central Vladikavkaz; Achanpyan district of Yerevan. The method and presentational environment used will provide a lasting foundation and framework for earthquake mitigation and "End-User" appreciation in these cities.

During a project visit 12 months ago, in December 2002, there were clear, demonstrable End-User links in Tbilisi. Political and democratic changes, expected then to be elections, meant that key **individual** contacts in End-User departments might come and go. With the Rose Revolution there is now a need to re-identify specific contacts and End-User departments and groups in Tbilisi.

• All four national groups in the project should maintain existing End-User participation despite changes of individuals "in post" in End-User departments; the Tbilisi group should re-identify specific End-User contacts and departments.

The earthquake monitoring network is developing gradually in Georgia (funding constraints) and at a greatly accelerated pace in Azerbaijan (other funds providing circa 14 new, networked stations and analysis capability). A major target for the integrated project teams remains the acquisition, interpretation and use of engineering geophysics data. This will bridge from seismic hazard to scenarios of building damage for risk management purposes. At the time of writing the groups in Tbilisi and Vladikavkaz had not received engineering geophysics equipment although funds had been transferred.

• The pursuit and receipt of these engineering geophysics equipment remains high priority to allow a fully coordinated approach to the microzoning component of the project. Pressure should be exerted on the equipment suppliers.

Individual scientific components of the project appear to be progressing well. There is much evidence of this in private, informal presentations in various departments and offices. Project Progress reports to NATO could be further enhanced if the main body of the text was a unified scientific document (rather than a compilation of reports from the individual groups), that contained the actual scientific results, maps and figures (rather than reporting such things as having been prepared) and highlighted areas of strong inter-group collaboration or individual group strengths that were available to others in the project. This would produce very strong reports from the material that seems to be available within this project. This step could also help to prime the production of good, international journal papers.

• It would be of benefit if the Progress Reports to NATO were fully integrated and scientifically complete project reports based on data and results emerging explicitly from the project.

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0. Itinerary, Outline of Meetings & Schedule

12.12.03/Fri: Paul Burton (PWB) travel to Tbilisi
13.12.03/Sat: Institute of Geophysics (IG). PWB, Tea Godoladze, Misha Elashvili, Tea Mumladze: Discussion on state of seismic network and its analysis; general discussion on project data and results
14.12.03/Sun: Institute of Structural Mechanics and Earthquake Engineering (ISMEE). PWB, Igor Timchenko and 5 colleagues: Discussion on engineering seismology aspects of project, with results and presentations on PC
15.12.03/Mon: 1) IG. PWB and Tamaz Chelidze in private: NATO Project Discussion on whole project, internal collaboration, NATO report style, scientific publication, equipment needs within project, need for re-identification of end users 2) Visit to one of the Seismology Department's stations in the seismic network [see Photos 1-3]
16.12.02/Tue: PWB depart Tbilisi

Photo. 1 Georgian Seismic Network. Tunnel leading to quiet vault for seismometer.

Photo. 2 Georgian Seismic Network. Seismometer on plinth in vault at end of tunnel in Photo. 1.

Photo. 3 Construction of oil pipeline. Local earthquakes monitored by developing seismic networks.

1. Objectives, Tasks, Amendments and Expected Products

Please see Burton's Project Evaluation Report following his 13-19 December 2002 visit to the project for full summary. Briefly:

Objectives. 1) Assess earthquake ground shaking potential in urban sectors of Baku, Tbilisi, Yerevan and Vladikavkaz (with all spatially varying data components of this objective maintained in easily exchangeable form in a GIS environment for project participants and end-users alike). 2) Develop a framework within which potential earthquake losses can be quantified in Baku, Tbilisi, Vladikavkaz and Yerevan, and mitigation techniques developed.

Tasks. 1) Compile up-to-date databases, necessary for estimation of seismic hazard and earthquake ground shaking potential assessment of large cities of Caucasus (updated seismic catalogues, strong motion data etc.). 2) Assess seismic hazard on regional and urban scales using different approaches. 3) Create scientific basis for seismic risk management: updated GIS-based seismic hazard, microzonation, exposure, vulnerability and seismic risk maps for selected objects (schools, hospitals, rescue teams, life-lines etc.) taking into account data on soil properties and possible zones with non-linear behaviour; create scenarios for most probable strong earthquakes. 4) Improve microzonation by developing, upgrading and operating local networks, taking into account different level of development and infrastructure in Caucasian republics. 5) Sharing information with participants of other similar projects. 6) Transfer elaborated material and knowledge to authorities of participating countries, with the aim of improving preparedness, planning prevention measures, management of major risks, and implementing insurance policy.

Products. 1) Easily upgraded GIS-controlled databases from which earthquake loss scenarios can be constructed for local urban areas in Baku, Tbilisi, Vladikavkaz and Yerevan and shared and discussed by project participants and end users alike to encourage informed earthquake mitigation and planning. 2) Maps of seismic hazard in the Caucasus, of earthquake ground shaking potential and scenarios of most dangerous seismic events in Baku, Tbilisi, Vladikavkaz and Yerevan. 3) A detailed vulnerability analysis of specific and representative building types: hospitals, schools, hotels, fire-fighting facilities, common type of apartment blocks etc. with accompanying report on retrofit possibilities for existing examples and potential for improvement in future design.

Note that the "specific spots" taken in each Caucasian city for detailed analysis are: 1) Tbilisi: Saburtalo district, 2) Baku: Sabail district, 3) Vladikavkaz: the central part of the city (Kuibishev, Vatutin, Tserethy streets, Peace Avenue etc.), 4) Yerevan: Achanpyan district

Note that project amendments include three linked aspects related to: 1) 25 April 2002 Tbilisi earthquake – Building Damage Database and Earthquake Vulnerability, 2) Increased availability of equipment to the project from other funding sources, 3) Increased opportunity for training within the project (see Burton's report following his 13-19 December 2002 visit to the project for details).

2. Training of Personnel

There is nothing new to report.

3. Industry and/or End-User

1) Tbilisi.
The 25 April 2002 Tbilisi earthquake emphasized the realities of earthquake risk to the city. During the Project Meeting during 12-14 April 2002 in Tbilisi, the Chairman Department of Emergency Situations and Civil Defence MIA of Georgia emphasized the "need in Tbilisi for scenario knowledge of what might happen in the event of intensity 6 and 7 MSK occurrences" **and** that there was a need for a national plan

to react to an emergency situation in conjunction with the need to know how to respond in **each** town/city in an emergency case. He did not know if there were sufficient resources to lead rescue teams in Tbilisi in the event of a 7 MSK occurrence. He did not know how old buildings would withstand vibration at even intensity 5 or 6 MSK. The situation has now changed beyond this. Firstly, scientific consideration is suggesting that scenario modeling of earthquakes (magnitude ~6) on two faults at circa 50 km from Tbilisi may constitute a higher risk than a smaller inner-city earthquake. Secondly, The so-called Rose Revolution means that it is essential to re-identify specific End-User contacts and departments. **There needs to be a continuing forum for communication of developing thought within the project and related implications.**

2) Baku, Vladikavkaz and Yeravan. I did not meet representatives from Baku, Vladikavkaz and Yerevan during this visit.

It remains the case that all concerned should make every effort to maintain and develop existing End-User participation despite changes of individuals "in post"; there is renewed need for this in Tbilisi.

4. NATO-Funded Equipment

1) The general influx of seismic monitoring equipment taking place beyond NATO SfP input has generated an excellent regional seismic network in Azerbaijan with network analysis capability. The network is developing in Georgia, despite funding constraints. There are strategic developments (e.g. oil pipeline) that will benefit from collaboration between developing seismic networks.

2) It was reported that the groups in Yerevan, and Baku (~September 2003), have received engineering geophysics equipment.

3) It was reported that the groups in Tbilisi and Vladikavkaz have long since ordered engineering geophysics equipment, that funds have been transferred, but delivery has not yet been achieved. **This should be pursued as high priority to facilitate mutual coordination of engineering geophysics measurements throughout the combined project.**

5. International Collaboration

Dr Zurab Javakhishvili (IG) is liaising with groups in Bishkek, Kyrgyz Republic, where a similar NATO Science for Peace project on seismic risk and management (Assessment and Mitigation of Seismic Risk in Tashkent, Uzbekistan and Bishkek, Kyrgyz Republic) is nearing completion.

6. R&D Management

This remains very good. The next big mutual tests remain as: the acquisition, interpretation and use of engineering geophysics data; followed by the transition from hazard to risk assessment. The Georgian team also has the 25 April 2002 Tbilisi earthquake Database and Case Study to deal with.

The overall project could benefit from enhanced, unified Project Progress Reports to NATO. There is also a growing need as the project advances to create a forum and channel of communication to convey results to End-Users and discuss their possible implications for risk mitigation.

7. Financial Management

This remains careful and good.

There is urgent need to press for delivery of engineering geophysics equipment to the teams in Tbilisi and Vladikavkaz. This should allow development of a fully coordinated approach to the microzoning component of the project.

8. IPR Management

This does not appear to be an issue.

9. Visibility of Project

See item 10 below. The project web site www.hangebi.com/sericicau was not available when access attempted and perhaps it could be reconfirmed.

10. Impact

The Rose Revolution has introduced a need to re-identify specific End-User contacts and departments. As project results and ideas emerge, and change, a channel of communication with End-Users is essential.

Enhanced Project Progress Reports to NATO would benefit the project. Such enhanced Project Reports could underpin the need to plan publication of results in international journal papers outside central Asia.

11. Overall evaluation and suggestions for improvement

The project is producing excellent results, much of which is made available at private meetings and discussions in various departments and laboratories. The programme of work is focussed, productive and meeting targets.

The project would benefit from enhanced Project Progress Reports to NATO.

- Firstly, existing documents correctly report that work has been done but do not necessarily present the scientific work itself (maps, figures, tables, references). It would be good if the content of these reports presented the work itself in full scientific detail. This is the first priority as the project advances into its later phases.
- Secondly, existing documents usually contain four essentially independent reports (with occasional scientific results being appended from the project within the Cacausus land area). It would be good to see an attempt at
  a) integration and comparison of all the scientific material on a topic (which would also reflect the work, methods and progress within the four groups),
  b) identification and description of collaboration on specific tasks that are taking place bilaterally, or between sets of three or even four groups in the project.

Enhanced Project Progress Reports to NATO should also help to move forward on the need to plan for the eventual publication of results on an international basis. This is often neglected while there are opportunities to acquire and deploy equipment and to capture new data – but this must be done.

The need to re-identify specific End-User contacts and departments has become very important since the Rose Revolution in Tbilisi. Channels of communication with End-Users should be used throughout the project to communicate results and emerging ideas so that their possible implications for risk mitigation are explored and two-way feedback maintained. This is vital in these later project phases.

It is not too early to begin preparation for an eventual project-wide meeting with End-Users at which all results are presented in relation to End-User feedback and known needs.

12. For the special attention of the Science for Peace Programme Office
(Actions to be taken by the SfP Programme Office, recommendations with respect to the overall management of the Science for Peace Programme)

In this project:

Please bring to bear whatever pressure you can to achieve rapid delivery of the outstanding engineering geophysics equipment.

In general:

In my opinion the opportunity exists to bring together the participants from all NATO inspired earthquake risk and mitigation projects. Such a conference would need to be held when all relevant projects are at a mature, publishing stage and should be open to invited End-Users to help transfer the knowledge gained.

Signature of NATO consultant: Paul W. Burton Date: 25 January 2004