MATHEMATICAL MODELLING FOR REAL-TIME FLOOD FORECASTING AND FLOOD CONTROL IN CENTRAL AMERICA

PLAN OF ACTIVITIES FOR 1995

GUATEMALA

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TABLE OF CONTENTS

1. INTRODUCTION

Within the present project Mathematical modelling for real time flood forecasting and flood control in Central America, modelling technology is being transferred to the six participating countries, including Guatemala. In 1993 and 1994 the main project activities have been an Inception Phase from January to July 1993 followed by a Data Collection and Training Phase from July 1993 to December 1994. The main activities have been data collection in the case study areas, regional workshops, two oversees training courses and transfer and installation of hard- and software to the participating Institutions. In January 1995 the project is entering into its Application and Consolidation Phase with a duration of two years.

The objective of the present document is to describe project activities during the Application and Consolidation Phase with special emphasis on project status, targets for 1995, identification of activities required to achieve these targets and a scheduling of the necessary inputs.

The document has been prepared by DHI in cooperation with Federico G. Chavarría (INSIVUMEH), Luis Ordoñez Hernández (INSIVUMEH), Luis Ochoa (INSIVUMEH), Gustavo Aldana (ERIS) and Pedro Tax, National Representative. The Counterparts Juan Jose Sandoval (ERIS/INDE) and Carlos Gordillo (ERIS) were not present in Guatemala City during the time of planning.

2. PROJECT STATUS

Below is given a short status of the project as of February 1995.

2.1 Institutional framework

Three institutions are participating in the project:

Instituto de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH)

INSIVUMEH includes the national hydrological and hydrometrical service. INSIVUMEH operates approximately 50 of the hydrometeorological stations in Guatemala and serves also as hydrometeorological data bank. It is staff members from the Hydrological division of INSIVUMEH who have participated in the project activities in 1993-94.

Permanently INSIVUMEH is executing a number of hydrological studies in Guatemala, e.g. feasibility studies for irrigation and flood control. INSIVUMEH intends to apply the MIKE 11 modelling

technology as a standard tool in future studies.

INSIVUMEH has no standard procedures for data management, i.e. the storing and handling of hydrometeorological data. Various procedures and formats are applied. INSIVUMEH is aiming at applying the database facilities in MIKE 11 for an increasing number of stations in the future. Since INSIVUMEH is operating a number of hydrometeorological stations, it will also serve a public databank in the future.

Escuela Regional de Ingeniería Sanitaria y Recursos Hidráulicos, Universidad de San Carlos (ERIS).

ERIS is a part of the Engineering faculty at the University of San Carlos, which is the largest University in Guatemala. At the Civil Engineering Faculty. Various courses in hydrology and hydraulics are taught. Some of the courses includes simple modelling techniques, e.g. with HEC models. Workshops are also arranged to demonstrate hydrological and hydraulic modelling.

ERIS will play an important role in securing the project sustainability in the long term perspective.

ERIS will gradually include the modelling technology in courses (hydrology, hydraulics) at medium and advanced level as well as applying it for thesis and master thesis work. ERIS will develop course material and sample exercises for relevant courses. By interacting with INSIVUMEH, INDE and CILA, ERIS will also be able to provide the students with real-life data and model setup for investigations and thesis work.

Instituto Nacional de Electrificacion (INDE)

INDE is the national power company responsible for all power production in Guatemala. INDE also operates and maintains around 50 hydrometeorological stations, i.e. the same number as INSIVUMEH. INDE has not participated formally in the project activities in 1993-94. However, the chief of the hydrology section, Juan Jose Sandoval, who is also part time employee at ERIS has participated in the overseas training course. In July 1994 INDE has forwarded a request for participation in the project to CEPREDENAC. In December 1994 the Steering Committee approved INDE being included as participating institution assuming they will enter into an Operating Agreement with CEPREDENAC. This agreement is due to be signed mid February 1995.

INDE is also executing a number of hydrological studies every year and intends to apply the MIKE 11 modelling system as a standard tool for these studies. Future studies may include new feasibility studies and flood forecasting/warning in connection with new hydro power plant facilities. An increasing number of hydrometeorological data will be stored applying the MIKE 11 database facility.

INDE has special interest in applying the modelling system in Rio Chixoy. INDE intends to improve

the general operation of the chixoy reservoir. It is anticipated that INDE will be operating a possible telemetry system in the Rio Chixoy basin if such a system can be provided. INDE could then be responsible for executing daily flood forecasting/warning procedures.

Comision Internacional de Limites y Aguas (CILA)

CILA is an organization financed by the government of Guatemala with the objective of representing Guatemala in committees working on matters related to the regulation of international rivers. CILA is operating around 20 hydrometeorological stations in catchments and rivers next to the boundaries of Guatemala (Mexico, Honduras and El Salvador). CILA has approximately 57 staff members of whom 20 are working at the main office in Guatemala City. CILA cooperates with INSIVUMEH and INDE on a frequent basis, e.g. by exchanging hydrometeorological data.

CILA has not participated in the project in 1993-94. During the visit of the Consultant to Guatemala in February 1995, CILA has shown interest in participating together with INSIVUMEH, INDE and ERIS and has announced that they will forward a formal request for participation to CEPREDENAC before March 1995.

2.2 Counterpart staff

In total 4 counterparts have been attending the 6 month overseas training course in Denmark:

* Juan Jose Sandoval (ERIS/INDE), who is chief of the hydrological division at INDE and part-time professor at ERIS.

* Carlos Gordillo (ERIS), who is part-time professor at ERIS.

* Federico Chavarria (INSIVUMEH), who is hydrologist at INSIVUMEH.

* Luis Ordoñez Hernandez (INSIVUMEH), who is hydrologist at INSIVUMEH.

Luis Ochoa (INSIVUMEH) has participated in the data collection at INSIVUMEH and has provided home support during the overseas training courses.

The training of additional counterpart staff to operate the modelling system has been discussed with INSIVUMEH, ERIS and INDE. At present it is anticipated that through the next 2-4 years approximately 7 additional staff members (2 from INSIVUMEH, 2 from ERIS and 3 from INDE) will be frequent users of the modelling system given they will receive training and gain on-the-job experience in operating the modelling system.

2.3 Hardware and software installations

In total 4 hardware installations (PC, printer, UPS) have been made. Two installations at INSIVUMEH and two at ERIS. Proper earth grounding and air conditioning facilities are present. In February 1995 the MIKE 11 version 3.11 (for windows) has been installed on three of the computers. Backup procedures have been established. On the computer at ERIS severe virus problems were detected and solved in February 1995. Subsequently, virus protection procedures have been enhanced. Due to access problems in February 1995 it was not possible to install the MIKE 11 window version at one of the computers at ERIS. This installation will be upgraded during the next visit of the consultant in May 1995.

At INDE one MIKE 11 DOS installation have been made on a powerful PC computer provided by INDE.

In summary, 5 MIKE 11 installations are available at present for the flood modelling activities in Guatemala in 1995.

Based upon experiences from participating institutions installing unauthorised software on the supplied computers, is must be strongly recommended NOT to initiate any kind of software updating on the provided computers without consulting DHI in advance.

2.4 The Polochic/Cahabon case study

The selection of the Polochic/Cahabon river catchments was made mainly due to the relevance of flood control studies within the areas. The lower part of the Polochic catchment is flood prone. Frequently agricultural land and households are inundated and flood control studies seem justified in these areas. In the Cahabon river catchment a number of feasibility studies for new hydro power production will be carried out in the coming years, i.e. also in this catchment flood control studies will be relevant.

At the end of the Second Overseas Training Course a HBV and HD model setup for the Cahabon and Polochic catchments is established and intensive calibration efforts have been carried out using data from a period of more than 10 years.

The Cahabon model produces reasonable agreement between measured and simulated discharges as well as water levels but it has not been possible to make a detailed calibration of the Polochic model, due to lack of sufficient topographical and meteorological data.

The whole Cahabon setup has been transferred into FF mode and the update parameters have been calibrated. Simulations have been carried out and forecasts have been submitted with satisfactory results.

It is expected that INDE will be able to support the Polochic model with a substantial amount of additional hydrometeorological data. Only very limited additional amount of topographical data from

Polochic is available.

By utilizing the additional data from INDE it is likely that the calibration of the Polochic model can be improved considerably. This task can be carried out within the period February-May 1995. Hence, the selected model applications with the Cahabon/Polochic models can be carried out during the last half of 1995.

3. PROJECT TARGETS

The general immediate objectives of the present project has been defined as follows:

- o to enhance the capability of the countries to plan, design and operate flood mitigation measures.
- o to contribute to the improvement of flood preparedness programs by improving flood forecasts methods and increase lead times.

Through discussions with the institutions and counterparts involved in the project in Guatemala these objectives have been further detailed in more specific long and short term targets reflecting the needs and possibilities. The short term targets to be accomplished within 1995 are listed below:

3.1 Specific targets for 1995

- * **Final calibration of the Cahabon/Polochic model setup.**
- * **Application of the Cahabon/Polochic model for flood control studies.**
- * **The completion of a 3 week course in Guatemala for training of additional counterpart staff from the participating institutions.**
- * **The preparation of course material and computer exercises together with ERIS.**
- * **Participation of new counterparts in a Regional training course.**
- * **Improvement of the general data management at INSIVUMEH.**
- * **The execution of new applications within 2-3 new model areas.**

4. PROJECT ACTIVITIES

4.1 The Polochic/Cahabon Case study

4.1.1 Preparation of additional available hydrometeorological and topographical data from remaining periods and stations within the Polochic/Cahabon catchments.

Remaining hydrometeorological data (new stations, extended periods) shall be imported into the MIKE 11 databases. Available survey data shall also be imported. Part of the data are available at INDE and will be prepared by INDE staff. The databases must be complete by April 1995.

4.1.2 Final calibration of the Polochic/Cahabon model.

Following the completion of the databases, the Cahabon and especially the Polochic model must be recalibrated and final calibrations obtained by May 1995.

4.1.3 Model applications.

During the national training course and throughout the rest of 1995, the calibrated models shall then be used for flood control studies in the downstream part of the Polochic catchment which is flood prone and for preliminary hydro power feasibility studies within the Cahabon catchment.

4.2 Training

4.2.1 A 3 week course in Guatemala for training of additional counterpart staff from all participating institutions.

The training of additional counterpart staff from INSIVUMEH, ERIS and INDE (and possibly CILA) is very important for the sustainability of the project activities in Guatemala. It is anticipated that approximately 7 additional staff members (2 from INSIVUMEH, 2 from ERIS and 3 from INDE) will be frequent users of the modelling system given they will receive training and gain on-the-job experience in operating the modelling system. By allowing the participation of additional 3 students from ERIS, a national course with 10 participants seems appropriate.

Principal instructors will be the four trained counterparts assisted with one or two instructors from DHI/SMHI. The course shall comprise the basic elements from the HIS, HBV and HD modules with emphasize on application of the modules using data from the case study or new applications.

The course duration will be 3 weeks but with activities only half day (morning or afternoon). The

location and period is to be decided. Responsible for course planning and execution of the programme are the four trained counterparts.

4.2.2 Preparation of course material and computer exercises for ERIS.

As a support to the integration of the modelling technology at ERIS, the Consultant will assist in preparing computer exercises and lecture notes for the University courses. This will be carried out during the period of the national training course.

4.2.3 Participation in a Regional training course.

3-5 new counterparts shall be nominated for and participate in a Regional training course scheduled for november 1995. The nomination will be made shortly after the national training course.

4.3 New applications

4.3.1 General support to new applications.

Besides the final calibration of the Cahabon/Polochic catchments and subsequent model applications, the three participating institutions will select 2-3 new river catchments where HBV/HD modelling will be part of the study to be carried out. The selection will be based on an assessment of data availability, potential model applications and the extend of flooding/flood control problems in the basins.

Preparation of data and model setup will initiated in March 1995 and preliminary results will be ready prior to the national training course in Guatemala.

4.3.2 Improvement of the general data management at INSIVUMEH.

At INSIVUMEH hydrometeorological and topographical data are stored in various formats ranging from tables in annual reports to numerous formats on diskettes. It is the intention to standardize the database procedures by making most data available in MIKE 11 or HOMS format and to prepare interface software (small fortran programs) between these formats.

The Consultant will throughout 1995 assist in making the interface software.

5.1 Activity schedule and staff input (Guatemala)