1. INTRODUCTION

During the 1993-94 period, the project has completed the Inception Phase (January- June, 1993) for establishing the principal institutional framework and preparing the Project Implementation Plan, followed by the Data Collection and Training Phase (July 1993 - December 1994), which in each country has produced a core group of trained counterpart staff, model setup and preliminary calibration of the MIKE 11 model for selected case studies and installation of computer hardware and software at the participating institutions.

The Application and Consolidation Phase (1995-96) of the project has just been initiated, and in accordance with the decision made at the 4th Steering Committee Meeting held in December 1994, detailed planning of activities in each country have been undertaken by the Consultants in close cooperation with the Counterparts. A coordination and synthesis of the individual country programmes have subsequently been prepared to develop an overall regional programme, which hence provides an update and detailing of the Plan of Operation no. 3 discussed at the last Steering Committee Meeting.

The result of this programming of activities is presented in the present "Updated Plan of Operation for 1995" for the approval of the Steering Committee. To set the ground for the discussion of further activities, a brief summary of the principal status of the project at the onset of the Application and Consolidation Phase is given in Chapter 2. Chapter 3 subsequently provides an assessment of the anticipated achievement of the defined objectives for the project, and a description of the main strategy adopted for the Application and Consolidation Phase aiming at achieving specified objectives to the greatest extent. On the basis of these guidelines, individual country programmes have been defined (contained in Appendices B-G) which subsequently have been synthesized to form an overall regional programme (Chapter 4). This Chapter provides a brief description of the main elements of the overall programme, the principal schedule of activities and required staff inputs. The estimated cost to the project for the implementation of the overall programme is finally presented in Chapter 5.

2. SUMMARY OF PROJECT STATUS

In this Chapter an overall summary of the status of the project at the beginning of the Application and Consolidation Phase is given, taking into account the progress made during the first two months of 1995.

2.1 Institutional Framework

CEPREDENAC

The project is implemented through CEPREDENAC, which is acting as the coordinating body on the regional level providing support to the management of the project, drawing upon the services of the Executive Secretary and the Regional Flood Coordinator. To strengthen the

administrative capacity of the Secretariat, the project is presently financing the salary of one accountant and one secretary.

Duties of CEPREDENAC in relation to the project includes:

- o arrange for operating agreements with the participating institutions
- o assist in preparation of events and activities on the regional level, ie. regional workshops, regional training courses, Steering Committee Meetings
- o accounting in connection with above activities including other regional coordinating activities
- o preparation of monthly financial reports to DHI
- o provide logistics support to the Consultant while visiting the region
- o ad-hoc coordination and communication with National Representatives and participating institutions

CEPREDENAC is in the process of obtaining a legal recognition in all countries, which in principle will allow CEPREDENAC to obtain financing of its Secretariat function from the participating countries and develop into an autonomous regional organization. So far, legal recognition has been obtained from El Salvador, Nicaragua and Honduras, which is sufficient for securing the further support from ASDI. This support, however, will gradually be phased out over the next three years.

National Institutions

At the initial stage of the project, a brief institutional review was undertaken in all countries to identify institutions with relevant responsibilities related to flooding problems and sufficient capacity for absorbing the mathematical modelling technology being offered. This resulted in the principal *hydrometeorological institution* in each country being selected for participation in the project, see Table 2.1 below.

To strengthen the national capacity for sustaining and further dissemination of the technology in the longer term, one *university* with relevant curriculum was also selected in each country, see Table 2.1.

In parallel with the institutional review, a review of potential case studies with significant flooding problems of national interest was undertaken. In the case study areas identified in Honduras, El Salvador, Costa Rica and Panama, the *energy and hydropower (HP) utilities* are in charge of the operation of dams located upstream of the flood prone areas. Recognizing that the actual operation of the dams has a direct impact on the extent of flooding downstream, it was obviously important to secure their participation in the project. In the case of Panama, IRHE is

both serving as a hydrometeorological institution and a HP utility.

The keen interest of the HP utilities in the project is due to the fact that the MIKE 11 modelling system may not only serve the purpose of alleviating downstream flooding by means of improved operation of the dams, but may also provide a basis for improving water management in general, such as enhancement of hydropower generation, improved drought management, and support to feasibility studies in respect of the hydrological, hydraulics and sediment transport aspects.

The HP-utilities of Guatemala and Nicaragua have recently issued a request for participation in the project, and in accordance with the decision made on the 4th Steering Committee Meeting, the project is currently in the process of entering into an operating agreement over their participation.

The *Emergency organisations* have so far only been loosely connected to the project. Only in the case of Costa Rica and Honduras a direct link is secured through the National Coordinator. The Emergency organisations forms potential end-users of the capability being built with the other institutions participating at the technical level in respect of their capacity for undertaking investigations related to flood hazards and flood control, or operating flood warning systems.

Table 2.1 National participating Institutions

COUNTRY	HYDROMET	HYDROPOWER	UNIVERSITY	EMERGENCY
COSTA RICA	IMN/ICE	ICE	UCR	CNE (2)
EL SALVADOR	DGRN	CEL	UCA	
GUATEMALA	INSIVUMEH	INDE (1)	ERIS	
HONDURAS	DGRH	ENEE	UNAH	COPECO (2)
NICARAGUA	INETER	INE (1)	UNI	
PANAMA	IRHE	IRHE	UTP/CIHH	

Notes: (1): Operating Agreements in progress
(2): Connected to the project via the National Representative

2.2 Counterpart Staff

During the first two years of the project a total of some 35 staff from the participating institutions have briefly been introduced to the modelling system as part of the regional workshops held. 22 of those have furthermore attended a comprehensive six month training course in Denmark providing each counterpart with a good understanding of the capabilities and

limitations of the MIKE 11 system, and some experience in the setup, calibration and application of the modelling system.

In Table 2.2 an account of the origin of the trained counterparts is given in terms of the country and type of institution. In the cases where a counterpart is working at two institutions, a '½' has been used to indicate this situation.

As part of the programming of activities in each country recently undertaken, spreading of the know-how to colleagues within the participating institutions have been discussed. In all countries a significant potential and interest for the further dissemination of the technology exist, which in some countries already has started. The last collum in Table 2.2 shows the total number of staff identified which eventually may become users of the modelling system given adequate training can be arranged.

Table 2.2 Number of core counterpart staff and new candidates

COUNTRY	HYDROMET	HYDROPOWER	UNIVERSITY	NEW CANDIDATES
COSTA RICA	1	2	1	10
EL SALVADOR	1	1		8
GUATEMALA	2	½	1½	7
HONDURAS	1	2½	½	6
NICARAGUA	3		1	10
PANAMA		1	3 (*)	8

Notes: (½): Indicates part time employment
(*): Two of those are employed with CIHH concentrating on research and consulting activities

2.3 Hardware and Software Installations

Immediately after the completion of each of the training courses, hardware and software has been installed at the participating institutions, to provide each of the trained counterparts with a hardware platform (powerful PC, printer, UPS) and software (MIKE 11 and ancillary software) allowing him/her to continue working with the modelling system in general, and the case study in particular.

After the return of the first group of trained counterparts to the region, requests for additional software installations were made by certain institutions to allow a more efficient training of other colleagues. In accordance with the decision made at the last Steering Committee Meeting, the Consultant has subsequently made additional software installations as appropriate during his visit

in January-February 1995. The extra installations has been made on hardware provided by the institutions. The additional installations are provided free of charge for the duration of the project. The need for upgrading to permanent user licences and associated conditions shall be reviewed at the end of 1996.

In Table 2.3 a summary of the hardware and software installations presently available at the participating institutions is given as well as the number of requests for further installation which has not yet been fulfilled.

Table 2.3 Number of computer hardware and software installations

COUNTRY	HYDROMET	HYDROPOWER	UNIVERSITY	SOFTWARE IN REQUEST
COSTA RICA	1 - 1	2 - 4	1 - 2	0
EL SALVADOR	1 - 1	1 - 1	0 - 1	3
GUATEMALA	2 - 2	0 - 1	2 - 2	0
HONDURAS	1 - 1	2 - 3	1 - 1	3
NICARAGUA	3 - 3	0 - 0	1 - 3	3
PANAMA		1 - 3	3 - 3	1

Notes: 1 - 3: Indicates 1 hardware and 3 software installations

In addition to the above computer hardware and software, the project has also arranged for the delivery of telemetry equipment to Honduras comprising DCP's and other equipment for 18 hydrological field stations and one an automatic weather station, spareparts as well as a base station comprising two computers and software for automatic retrieval of the hydrological data. This equipment will allow for the automatic recording of hydrological parameters (primarily rainfall and water levels) and transmission via the GOES EAST satellite to a data collection facility in Maryland, USA from where data may be retrieved by the base station.

2.4 Case Studies

In the initial stage of the project, a review of possible case study areas were made in order to identify a suitable case study in each country which could both serve as an object for the overseas training course, and be able to demonstrate the practical usefulness of the modelling system in due time.

It has been an overall strategy of the project to direct the application of the modelling system to flood case studies of *high priority in order to stimulate an immediate national interest.* The

selection of case studies was therefore based on a thorough evaluation of available information related to socio-economic aspects, data availability, needs for further data collection and surveys, and requirements for telemetric networks. Special emphasis was given to the significance of the flooding problems on socio-economic activities in the areas, and to what extent flood forecasting, flood warning and/or flood control might help to solve existing problems in the areas in due time. Other related aspects such as optimization of dam operations for the joint benefit of hydropower production and flood control as well as more general water resource management aspects were also taken into consideration. The interest of the countries in applying the model for the particular case study areas also formed a very important parameter in the final selection.

In Table 2.4 the case study areas finally selected are listed. As part of the overseas training courses, a preliminary setup and calibration of the modelling system for these areas have been undertaken which has formed an integrated and important part of the technology transfer. After the return of the Counterparts, calibration of the models have been continued to prepare for the actual applications. This work is in various stages of completion in the different countries as indicated in Table 2.4, but are aimed at being finalised in 1995 in all countries.

Table 2.4 Case study areas and status of model calibration

COUNTRY	RIVER BASIN	Catchment Area (Km^2)	Model Calibration Degree Completed (%)
COSTA RICA	Reventazon	2,800	80
EL SALVADOR	Lempa	18,250	70
GUATEMALA	Polochic/ Cahabon	4,800	85
HONDURAS	Sula Valley	26,400	85
NICARAGUA	Escondido	11,700	60
PANAMA	Chiriqui Chiriqui Viejo	1,400 1,375	80 90

2.5 Main Outputs Produced

The project has successfully completed the planned activities for the Data Collection and Training Phase (July 1993 - December 1994). With reference to Project Implementation Plan contained in the Inception Report /3/, the project has produced the expected principal outputs at this stage, ie:

- Four trained staff from each country, except El Salvador with two trained staff, each having a good understanding of the capabilities and limitations of the MIKE 11 system and some experience in the setup, calibration and operation of the modelling system;

- Data collection, surveys, model setup and preliminary calibration and applications completed for one case study area in each country (two study areas in Panama);

- Transfer of computers (22) and MIKE 11 software installations (22 permanent user licences and 10 temporary licences) to all participating institutions in the region;

The only major problem experienced during the first two years of the project has been the lack of funds for establishment of telemetric networks in relevant flood-prone areas, originally anticipated to be provided by the regional FINNIDA/WMO project for rehabilitation of hydrometeorological networks within the region.

Since the project partly has been able to counteract this impact by raising the necessary funding for one telemetry system from its own budget and from other sources (ASDI), the project has furthermore produced:

- Purchase of a telemetry system for the Sula River Basin, Honduras and four trained technicians in the operation and maintenance of the system.

3. APPLICATION AND CONSOLIDATION PHASE, 1995-96

The programming of activities for 1995 has been based on an adopted strategy for the further project implementation during the Application and Consolidation Phase. This strategy has been developed on the basis of the actual status of the project (re. Chapter 2), experience obtained during the past project implementation, and not least the overall project objectives and outputs anticipated at the beginning of the project.

In the following an assessment is made of the extent to which the originally defined objectives and anticipated outputs can be achieved along with an outline of the proposed strategy forming the guideline for further project implementation.

3.1 Project objectives and specified outputs

The overall **immediate objectives** of the project has been defined as follows:

- to enhance the capability of the countries to plan, design and operate flood mitigation measures, and
- to contribute to the improvement of flood preparedness programmes by improving flood forecasting methods and increasing lead times.

The originally **planned outputs** of the project *directly related* to the Application and Consolidation Phase include:

- Application of the MIKE 11 modelling system to one or two high priority flood prone areas for flood hazard mapping, analysis of alternative flood control schemes and/or flood forecasting/warning;
- Information on the modelling system and its applications spread to other in-house staff and end-users, ie. organizations related to emergency operations, city planning, land use planning, agriculture, public works, etc.;
- Contribute to the consolidation of the existing cooperation across the region, including the exchange of information and experiences for mutual benefit and inspiration;

Finally, the Project Implementation Plan specifies the following activities as **the main elements** of the Application and Consolidation Phase:

- Re-calibration of the models for flood forecasting catchments based on data from telemetric networks;
- Final testing and operational application of flood forecasting and warning systems;

- o Application of models for detailed planning and design of flood control structures;
- o Regional workshops for the exchange and dissemination of information and experiences.

3.2 Anticipated Achievement of Project Objectives

Within its two first years, the project has made very good progress and has achieved the anticipated outputs at the present stage to an even greater extent than planned, ie. more trained counterparts and technology spread to more institutions, and has produced additional outputs not planned, ie. purchase of one telemetry system and trained staff in its operation and maintenance (re. section 2.5).

Although it is difficult at the present stage to assess precisely to what extent the project will be able to achieve the goals of the project as listed in section 3.1 above, it is unfortunately evident that the project will not be able to achieve all the specified objectives and outputs to the full extent in spite of the good progress made.

This is partly due to the failed contribution from the FINNIDA/WMO project regarding the telemetry systems, which has made it impossible to make actual applications of the modelling system for real-time flood forecasting and warning in relevant areas. Only in Honduras, where a telemetry system presently is being implemented in the Sula Valley Basin, it will be possible for the project to make an actual contribution to flood preparedness programmes by putting the scheduled flood forecasting and warning system into operation.

Even if financing for more telemetry systems was made available at short notice, it would still be impossible to achieve the objective in this regard within the present project period. This is due to the considerable timeframe required for the design and purchase of such systems, its installation and coupling to the mathematical model, the operational testing of the combined system and building the required capacity for its sustainable operation. In the Consultant's Memorandum of January 1995, /17/, it is assessed that this will require a total period of not less than 3 years, excluding the necessary time to put the financing in place. The Memorandum furthermore provides a review of the needs and potential benefits of telemetry systems in the selected case study areas, as well as a skeleton budget.

Regarding the first objective, there is little doubt that the project will be able to enhance the capability of the countries to plan and design flood mitigation measures, and in addition make other valuable contributions. The latter contributions are related to the more general uses of the modelling system for data management, hydrological and hydraulic investigations, etc. which has strengthened the capability of the participating institutions in water management in general.

A crucial question is, however, whether this capacity being built by the project can be sustained after the termination of the present project period.

Regarding the sustainability of the capacity at the participating institutions, a considerable number of staff from the region have attended the overseas training course (22 in total). This staff, however, originate from 6 different countries, and with 2-3 institutions participating in the project in each country, the present capacity is very limited in most institutions. With reference to Table 2.2, it is noted that only 2 of the 17 participating institutions have 3 trained staff, while 11 of them have only one, or less, employee properly trained (this statistics assumes INDE and INE having joined the project).

Hence, there is no doubt that it will be a prerequisite for long term sustainability, to further expand and consolidate the capacity presently available at the participating institutions. This is particularly so, in view of the fact that some of the trained counterparts may leave their present positions in favour of more attractive jobs in the private sector or be promoted to management positions within their own organisations. This represents a considerable risk to the project, and every effort must be done to secure the trained counterparts in their existing positions, which among others can be supported by their continuous involvement in a technically challenging activity. The failure of FINNIDA/WMO project to provide the telemetry component, may also have negative consequences in this respect, since it may be feared that some counterparts may loose interest if there is no hope for bringing the modelling work related to flood forecasting and warning into practical use which has been aimed at from the beginning.

During the recent visit undertaken by the Consultant to all participating institutions, a strong interest and enthusiasm was in general experienced, as evidenced by the considerable number of staff which has shown an interest in becoming involved in the project, see Table 2.2. This certainly gives hope for establishing a sufficiently large group of trained staff at most institutions and hence one of the basic requirements for long term sustainability.

It must be realized, however, that the capacity strengthening will take time, and it would be overly optimistic to assume this process completed within the present project period (ie. less than two years), considering the considerable number of staff to be trained, the limited resources of the already trained counterparts and available inputs from the Consultant, and not least the time required to absorb the modelling technology, including the development of the associated professional skills to ensure its proper application.

At the universities, staff tends to change to other jobs less frequently, and there is hope that the trained staff slowly will disseminate the acquired skills to colleagues and prepare the incorporation of mathematical modelling techniques in the teaching and research programmes. This will undoubtly help to strengthen sustainability, but primarily only in the rather long time perspective, and cannot replace an insufficient capacity at other national institutions.

From the above it is concluded that the project requires telemetry systems for more areas, as well as more time and resources to achieve its objectives. It is noted that the latter part of this conclusion fully agrees with the findings and recommendations during the preparation stages of the present project, clearly expressing the expectation that the project must be continued beyond the present project period to achieve sustainable results.

3.3 Strategy

In order to achieve the objectives of the project to the greatest extent within the present project period, it is important to direct the further efforts of the project into three main directions, namely:

(i) strengthening the modelling capacity of the participating institutions;

(ii) making useful applications of the modelling system to the selected case studies, and

(iii) making potential end-users aware of the capability available at the participating institutions.

The above requirements are deemed to be prerequisites for achieving the necessary sustainability of the transferred technology and know-how within the region in due time, since it will be difficult to maintain the use of the technology in the longer term without a demand from end-users, which subsequently requires convincing case studies to achieve general acceptance, and not least a sufficiently large group of adequately trained staff, capable of sustaining the know-how in the long term.

In some cases participating institutions are end-users themselves, but also in these cases it appears very important to proceed with the model applications to demonstrate its usefulness for gaining acceptance and a better understanding of its potential at the management level. In many institutions, the qualified human capacity is presently limited to only one counterpart having attended the overseas training course. This is a potential risk to the project at these institutions, and every effort should be made to maintain the counterpart in his/her's present position, and encourage the dissemination of the know-how to colleagues as quickly as possible.

In view of the above, it is proposed to set the *main targets* of the project for the Application and Consolidation Phase as follows:

- *demonstration of* the usefulness of the modelling system through its *actual application* to the selected case study areas or other relevant studies;

- *consolidation* of the Counterpart's *know-how and experience* through their active participation in the application of the modelling system;

- *strengthening the capacity of the participating institutions* through further dissemination of the technology and know-how (in-house and regional training courses and implementation of post graduate courses and research programmes at universities);

- promotion of the capability available at the participating institutions through *dissemination of the results* of the project to potential *end-users*.

The above should hence serve as the principal guidelines for the direction of the further project

activities. At the same time, it is also important to note that the initiation of the Application and Consolidation Phase signals several important changes within the project which is important fully to appreciate and adapt to. Among these are:

- a *change of location:* Until now, most of the project activities have been located in Denmark; from now on, the far majority of the activities will occur in the region;

- *a change in emphasis:* Until now, the focus has been on the training element with the instruction being provided by the Consultant. This will gradually change with more emphasis being directed towards applications of the models, yet with a proper allowance to ensure the dissemination of know-how;

- *a change of roles:* Until now, the Consultant have had the greater share of the responsibility and initiative in relation to the execution of the project; the Consultant will still be responsible towards Danida for project execution, but his role will gradually change into a supportive capacity only, being available to respond to local initiatives for which the participating institutions will take the main responsibility.

The primary reason for these changes is the basic requirement of making the technology transfer to the region sustainable in the long term, implying that the national partners gradually shall take over greater elements of the project while the support of the Consultant is being reduced at the same time. With the initiation of the Application and Consolidation Phase, this process has been started, yet in a pace recognizing that the successful completion of this process takes time.

The above has direct implications for the way further project activities will be implemented in the region, the principal guideline being that the national partners should take over roles and functions corresponding to their capacity, while the Consultant's support shall be concentrated on those activities in most need of professional assistance. The application of these principles will directly affect the project in the present year as indicated below.

Project Management: It will not be desirable, and certainly not possible, for the Consultant solely to manage the project in an adequate way, considering the very large number of partners now participating in the project, and all activities occurring in the region. The members of the Steering Committee, ie. the Executive Secretary of CEPREDENAC, the Regional Coordinator, and the National Representatives will all be required to play an active role in the supervision and coordination of activities on the national and regional levels (see subsequent section).

Training: In connection with all future training activities (in house introduction courses and regional courses), the trained counterparts will be required to act as the principal instructors, yet with support from the Consultant for the preparation of the courses and ad-hoc assistance.

Model Applications: The counterparts have since the very beginning been responsible for the model applications to the case studies, but have had access to day-to-day support during the training courses. In this year, the assistance will be reduced to comprise 2-3 visits of a duration which will be attempted to be tailored to the actual need for solving specific problems in connection with the application to the case study, or new areas.

3.4 Project Coordination and Management

The project is basically a *regional project*, with activities on the regional as well as on the national levels. Until now regional activities have dominated, but with the initiation of the Application and Consolidation Phase, the far majority of the activities will be implemented at the *national levels*.

With the project in full operation in all 6 countries, encompassing 18 institutions and the active participation of 22 counterparts and more to join, project coordination and managements requires particular attention to ensure an efficient implementation of activities at all levels. In response to these requirements, an adequate project organisation structure was established at an early stage of the project. This framework comprises the National Representatives (NRs), the Regional Coordinator (RC), the Consultant's Team Leader (TL), a Project Management Group (PM), and the Steering Committee (SC). A description of this organisation, and the roles and functions of the partners involved is given in the Project Implementation Plan, included in both /1/ and /3/.

Due to the emphasis on the overseas training within the first two years, the need to put all anticipated roles and functions into full operation has so far been limited. The further successful implementation of the project in the region, however, will require that all partners concerned contribute to the strengthening of the coordination and management functions by undertaking the agreed tasks within the project organisation.

With reference to the description given in /1/ and /3/ these includes:

National Representatives (NRs)

- serve as a direct link of communication between the participating institutions/ counterparts and the SC regarding progress, problems, requests, strategy, etc.
- monitor project activities at participating institutions and coordinate as appropriate;
- responsible for production of national progress reports and work plans;
- liaise with the RC regarding regional activities;

Regional Coordinator (RC)

- monitor overall project implementation at the national levels in cooperation with the NRs;
- coordination of regional activities;
- assist in the preparation of regional progress reports;

Consultant's Team Leader (TL)

- coordination and supervision of Consultant's staff and other inputs;
- assignment and timely fielding of qualified staff in response to agreed Plan of Operations;
- monitor overall project implementation at the regional and national levels in cooperation with the RC and NRs;
- responsible for the production of the regional progress report;

Project Management Group (PM)

- implementation of decisions and directions given by the SC;
- day-to-day management of the project resources in cooperation with the TL, RC and NRs;
- monitor overall project implementation and production of outputs;
- maintain record of expenditures and financial status of the project;
- responsible for preparation of the annual Plan of Operation;
- arrange for operating agreements with participating institutions;
- coordination with other projects;

Steering Committee (SC)

- Monitor project execution;
- coordinate overall implementation of the project on the regional and national levels;
- review progress, production of outputs and achievement of objectives;
- review reports and provide comments and advise;
- agree on an annual Plan of Operation, including reallocation of funds;
- agree and recommend on any uses of the contingency funds;