

Document of  
**The World Bank**

**FOR OFFICIAL USE ONLY**

LN 3325-IN  
CR. 2241-IN

**Report No. 9391-IN**

**STAFF APPRAISAL REPORT**

**INDIA**

**DAM SAFETY PROJECT**

**APRIL 19, 1991**

Agriculture Operations Division  
Country Department IV  
Asia Regional Office

**This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.**

### CURRENCY EQUIVALENTS

(As of end of January, 1991)

Currency Unit = Indian Rupee (Rs)

US\$ 1.00 = Rs 18.58

Rs 1.00 = US\$0.054

### FISCAL YEAR

GOI, States: April 1 - March 31

### WEIGHTS AND MEASURES

The metric system is used throughout the report

### LIST OF ACRONYMS AND ABBREVIATIONS

CWC	Central Water Commission
CWC-DSO	Central Water Commission-Dam Safety Organization
DSRP	Dam Safety Review Panel
GOI	Government of India
GOMP	Government of Madhya Pradesh
GOO	Government of Orissa
GOR	Government of Rajasthan
GOTN	Government of Tamil Nadu
ICOLD	International Committee on Large Dams
IMD	India Meteorological Department
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
O&M	Operation and Maintenance
SDSO	State Dam Safety Organization
SOE	Statement of Expenditures

INDIA

DAM SAFETY PROJECT

STAFF APPRAISAL REPORT

Table of Contents

	<u>Page No.</u>
I. <u>LOAN/CREDIT AND PROJECT SUMMARY</u> .....	1
II. <u>WATER RESOURCE DEVELOPMENT</u> .....	3
Agriculture in the National Economy .....	3
Development Priorities .....	3
Water Resource Development .....	3
National Dam Safety Program .....	4
Bank Group Support .....	5
III. <u>THE PROJECT</u> .....	5
Rationale for Bank involvement .....	5
Project Area .....	5
Project Objectives .....	6
Project Description .....	6
Detailed Features - National Level .....	7
Detailed Features - Participating States .....	8
Project Implementation, Organization and Management.....	9
Monitoring and Evaluation .....	11
Environmental Impact .....	11
Operation and Maintenance, and Cost Recovery .....	12
Status of Preparation and Implementation Schedule .....	12
Project Costs .....	12
Financing Plan .....	13
Procurement .....	14
Disbursements and Financial Arrangements .....	16
Project Accounts, Audits and Reports .....	17
Project Benefits and Justification .....	17
Project Risks .....	17
IV. <u>AGREEMENTS AND RECOMMENDATION</u> .....	18

The project is based on the findings of an IBRD/IDA appraisal mission which visited India in December 1990. The mission consisted of Messrs. W. Price (Task Manager), C. J. Perry, R. K. Malhotra and Ms. N. Mattson (Bank), and Messrs J.R. Malhotra, Y. K. Murthy, L. Duscha (consultants). The report has been endorsed by Mr. H. Vergin (Director) and Mr. J. Wijnand (Division Chief). Assistance was also provided by peer reviewers Messrs. G. LeMoigne, P.N. Gupta, and W. Dobisch.

This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.

LIST OF ANNEXES

	<u>Page No.</u>
Annex 1: Dam Safety in India .....	20
Annex 2: Institutional Strengthening of Dam Safety Organizations	33
Annex 3: Basic Dam Safety Facilities .....	41
Annex 4: Evaluation of the Flood Handling Capability of Existing Dams and Spillways .....	44
Annex 5: Remedial Works .....	48
Annex 6: Dam Safety Review Panels .....	56
Annex 7: Expansion of Flood Forecasting Networks .....	64
Annex 8: Training, Workshops and Consultancies .....	67
Annex 9: Environmental Assessments .....	72
Annex 10: Monitoring and Evaluation .....	74
Annex 11: Summary of Cost Accounts .....	76
Annex 12: Schedule of Disbursements .....	99
Annex 13: Implementation Schedule .....	100
Annex 14: Procurement Schedule .....	101
Annex 15: Bank Supervision Input into Key Activities .....	102

INDIA

DAM SAFETY PROJECT

STAFF APPRAISAL REPORT

I. LOAN/CREDIT AND PROJECT SUMMARY

Borrower: India, Acting by its President

Executing Agency: Central Water Commission, Government of India

Loan and Credit Amounts: IBRD: Loan US\$23.0 million equivalent  
IDA: Credit SDR 96.2 million  
(US\$130 million equivalent)

Project Beneficiaries: Government of Madhya Pradesh (GOMP)  
Government of Rajasthan (GOR)  
Government of Orissa (GOO)  
Government of Tamil Nadu (GOTN)

Terms: IBRD loan: 20 years, including 5 year grace period, at the Bank's standard variable interest rate.  
IDA credit: Standard with 35 year maturity.

On-lending Terms: GOI would make the proceeds of loan and credit available to states under standard arrangements for developmental assistance to the states. GOI would assume the foreign exchange risk.

Project Description: The project would strengthen existing agencies responsible for dam safety assurance in the Central Government, and the four states of Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu. This would include upgrading standards and procedures for dam safety inspections and review. Rehabilitation works would be carried out at selected sites where deficiencies have or will be identified and basic safety facilities such as communications, access roads, and standby power generation facilities would be upgraded at important existing dams. Hydrometeorological data collection and early flood warning systems will be installed on one or more river basins involving inter state operations.

Benefits and Risks: The project would increase the assurance of safety of dams in the participating states, thus reducing the risks in these states against loss of life and property. The major risk to the project would be inability of the states to fund the local contribution of remedial works.

Estimated Project Cost

<u>Components</u>	<u>Local</u> - - - -	<u>Foreign</u> (US\$ million)	<u>Total</u> - - -
CWC Institutional Strengthening	2.7	0.3	3.0
Flood Forecasting Systems	5.2	3.7	8.9
States Institutional Strengthening	7.6	1.3	8.9
States Basic Safety Facilities	18.8	5.6	24.4
States Remedial Works	<u>116.9</u>	<u>10.0</u>	<u>126.9</u>
Total Base Costs	151.2	20.9	172.1
Physical Contingencies	25.1	3.0	28.1
Price Contingencies	<u>-5.9</u>	<u>2.5</u>	<u>-3.4</u>
Total Project Costs <sup>1/</sup>	170.4	26.4	196.8

Financing Plan

	<u>Local</u> - - - -	<u>Foreign</u> (US\$ million)	<u>Total</u> - - - -
GOI	5.3	0.2	5.5
Participating States	37.3	1.0	38.3
IBRD/IDA	<u>127.8</u>	<u>25.2</u>	<u>153.0</u>
TOTAL	170.4	26.4	196.8

Estimated Disbursements

(US\$ million)	FY92	FY93	FY94	FY95	FY96	FY97	FY98
Annual	15.6	16.9	22.9	35.2	33.7	26.1	2.6
Cumulative	15.6	32.5	55.4	90.6	124.3	150.4	153.0

Economic Rate of Return: Not Applicable

<sup>1/</sup> Including taxes and duties of US\$7 million

## II. WATER RESOURCE DEVELOPMENT

### Agriculture in the National Economy

2.1 India has a land area of 3.27 million km<sup>2</sup> of which 49% is cultivable and about 16% irrigated. The population of about 810 million, is growing at an annual rate of about 2%. GNP grew at little more than 3% per annum in the period prior to 1980, but has averaged over 5% in recent years. Per capita GNP reached US\$346 in 1989/90. Average per capita income has increased, but there has been limited progress in the living standards of the urban and rural poor with some 280 million people having annual incomes below the poverty line and 80% of whom live in rural areas. Agriculture contributes about 33% of GNP, and remains a key sector in the national economy, despite its recent declining share of GNP. It engages two-thirds of the total labor force and accounts for about 18% of India's merchandise exports.

### Development Priorities

2.2 Development plans of the Government of India (GOI) and state governments give priority to alleviating poverty and creating employment, especially in rural areas. The primary determinant of rural incomes, especially for the poor, is the performance of the agricultural sector. Since independence, GOI development plans have emphasized agriculture and sought to raise foodgrain production by increasing the use of fertilizers, plant protection chemicals, and improved seed varieties. In support of these objectives, GOI has strengthened the institutions supporting the sector and, particularly, has accelerated the development of irrigation. As a result of these efforts, the annual growth rate in foodgrain production over the last 15-20 years has averaged 2.6%, slightly above the population growth.

### Water Resource Development

2.3 The future of Indian agriculture is inextricably linked to the performance of irrigation. India's arable land is fully cultivated: there has been virtually no expansion in net cultivated area since the 1970s. Growth of output thus depends on sustaining and expanding the area under irrigation, increasing productivity of rainfed and irrigated crops and diversification to higher value crops.

2.4 India is a water-short country in relation to municipal and industrial needs, as well as for agriculture, which is the major user. In India, water resource development almost invariably involves surface storage of water, because rainfall is inadequate, even during the monsoon months, to mature water-sensitive high yielding varieties. Furthermore, the concentration of much of the annual rainfall and runoff in the monsoon months (typically 80% of runoff occurs in three months) requires storage so that supplies for crops, people, livestock and industries can be assured during the dry season.

2.5 These needs can be met to some extent from naturally stored infiltration to groundwater, but much of India is underlain either by poor quality groundwater, due to natural salts, or has no exploitable aquifers. In

such cases, surface reservoirs, where suitable sites are available, present the only option for assured, continuous availability of water.

2.6 Some 35 million ha are currently served by irrigation by water stored by over 2,900 large dams. The number of facilities owned and operated by central and state governments in India is among the highest of any country in the world.

2.7 Surface storage also provides two other important potential benefits—hydropower, and flood control. Power is a major constraint to economic development in India, and hydropower provides a cheap, and environmentally clean source. Floods are a recurring threat to vast areas of India. Lives, property and standing crops are lost each year. Storage dams provide the means to dramatically reduce damages by storing peak flows and releasing water at lower rates after appropriate warnings to downstream areas.

#### National Dam Safety Program

2.8 Dam safety assurance is of continuing concern wherever loss of life or property would be threatened by a failure, and most countries including India, have laws, regulations and organizational arrangements designed to minimize such hazards. Such arrangements are, however constantly evolving as a result of new analytical techniques, unexpectedly severe natural events, or new legislation. Thus, major reforms to the procedures for ensuring safety in many countries were introduced quite recently, for example in 1972 in the US, and in 1975 in the UK.

2.9 The Central Water Commission (CWC) has general responsibilities for setting standards and criteria to be followed in dam safety throughout the country. Through their monitoring and review functions for projects proposed for central support in the State Development Plan, CWC also exercises a broader quality control function, including technical overview of the analyses on which new project designs are based. In addition, since irrigation is a state responsibility, CWC ensures that projects on inter-state rivers are consistent with downstream safety requirements, an important role which individual states cannot undertake. In 1979 the CWC Dam Safety Organization (CWC-DSO) was established with the purpose of assisting states in evaluating safety-related hazards in existing structures.

2.10 In 1982 a committee was constituted by GOI to review existing practices of inspection and maintenance of dams and set out national standards for dam safety. The committee's report—Dam Safety Procedures—was issued in 1986, followed in 1987 by 'Guidelines for Safety Inspection of Dams' which sets out standards which reflect the dam safety philosophy of the International Commission on Large Dams (ICOLD).

2.11 Inadequate flood handling capability is the most common cause of dam failures. Checking and upgrading the hydrologic capability is thus a key technical issue in a national dam safety program. The CWC-Hydrology Organization has an active program to perform the hydrologic analysis and recomputation of the design flood for some 55 nationally important dams throughout the country, as well as providing assistance, as requested, to state governments, and performing mandatory hydrologic review of dams that are a part of new major irrigation projects.

2.12 India's constitutional framework gives each state the primary responsibility with respect to water resource development. While the central agencies such as CWC, have substantial authority to issue guidelines, and review standards, they have virtually no powers of actual enforcement. However, the present capacity to carry out effective dam safety assurance programs varies substantially from state to state due to staffing levels, training, degree of experience and procedures. While dam safety assurance is a joint concern of the state and central organizations, it is the state which must eventually provide the necessary staff and equipment to monitor the population of dams within the state.

#### Bank Group Support

2.13 India's development efforts have attracted substantial support from the Bank Group. The Bank has been heavily involved in funding irrigation, power, and water supply projects over the last fifteen years, and these projects have involved directly or indirectly some 150 dams. There has been an extensive dialogue between the Bank, central agencies, and various state authorities on the scope and responsibilities for dam safety in relation to specific Bank funded projects in irrigation, power, water supply and flood control.

### III. THE PROJECT

#### Rationale for Bank Involvement

3.1 The Bank's assistance strategy to India is to support policies and investments that promote economic growth and social development in a context of macro-economic restructuring. The emphasis is on efficient resource allocation, increased efficiency in the public sector, and the appropriate targeting and delivery of support systems to the poor.

3.2 Water resource development is a central element of this strategy. The process of dam safety assurance, which is of continuing concern wherever life or property would be threatened by a failure, is necessarily a public sector activity: an efficient system reduces risks, and helps assure sustainability and full operational capacity of existing storage reservoirs through the early rectification of problems. Based on its long involvement in the sector, and experience with the institutions involved both at the center and in the states, the Bank is particularly well placed to assist India in developing the institutional framework required to support and fully implement India's existing policies and procedures in dam safety.

#### Project Area

3.3 The project would be implemented throughout the states of Madhya Pradesh, Rajasthan, Orissa and Tamil Nadu. The large dams in these states are located in major river basins to provide storage for irrigation, flood control, municipal and industrial use, and hydropower. The priority of works will be established under the project according to urgency and the status of the preparation of the remedial action plans. The total of 947 large dams, and the

33 proposed to receive initial remedial action based on existing information, are distributed among the four states as follows:

<u>State</u>	<u>Number of Large Dams</u>	<u>Number of Dams to Receive Remedial Action</u>
Madhya Pradesh	608	8
Rajasthan	124	7
Orissa	131	9
Tamil Nadu	<u>84</u>	<u>9</u>
Total	947	33

#### Project Objectives

- 3.4 The project would have two primary objectives:
- (a) to strengthen the institutional framework for Dam Safety Assurance in CWC and in the four participating states; and
  - (b) to upgrade the physical features in and around selected dams to enhance their safety status as required through remedial works, basic facilities additions, and flood forecasting systems.

#### Project Description

3.5 In the Central Water Commission, the project would strengthen the existing central Dam Safety Organization (CWC-DSO), the Hydrology Organization, and the River Management Wing through assignment of staff, training, technical assistance, provision of equipment, and consultant support as required. The four participating states were self-selected for involvement in the project and each prepared initiating reports to CWC supporting their proposed activities. An additional four states have expressed interest in participating in a similar dam safety project. In addition, the project would support evaluation and construction of a network of flood forecasting facilities in one or more interstate river basins.

- 3.6 In each of the participating states, the project would support:
- (a) technical assistance to the State Dam Safety Committee, which has overall responsibility for the State's program, determining priorities for studies, investigations, and remedial works;
  - (b) a strengthened Dam Safety Organization, responsible for inspection of dams, analysis of information and making reports and recommendations to the State Dam Safety Committee;
  - (c) upgraded safety facilities (power backup systems, communications, all-weather access roads, monitoring instrumentation, etc) at priority sites;
  - (d) investigations and rehabilitation works at dams where potential safety-related deficiencies have already been identified, and at other dams which will be identified and prioritized during execution of the safety assurance program.

Detailed Features-National Level

3.7 Strengthening Central Water Commission (US\$3.0 million, 1.5% of base cost, Annex 2). The Central Water Commission would expand its existing responsibilities in dam safety administration, hydrologic analysis, and operation of the national flood forecasting network.

3.8 Dam Safety Administration and Training (Annex 8). The CWC-DSO would continue and expand its activities in formulating and disseminating national standards and guidelines, assembling dam safety technical publications, and assisting states directly, upon their request, in dam safety-related issues. In addition, specific training materials would be developed, including computer simulation software for training gated spillways operators in responding to various flood events.

3.9 Hydrologic Analysis (Annex 4). Recent advances in recognizing and computing the magnitude and characteristics of extreme flood events, and revisions to the Indian engineering standards for most large dams, require re-evaluation of many existing structures. Under the project, the approach to assessing flood handling capability of existing dams and spillways would be upgraded. Precipitation estimates, which are basic inputs to computing design flood magnitudes, are presently calculated on a case-by-case basis by the Indian Meteorology Department (IMD). This process is adequate for the limited number of new dams under planning and design, but is insufficient for the reassessment of the large number of existing dams.

3.10 Under the project, regional maximum precipitation estimates would be assembled and made available as atlases by IMD, together with guidelines for selection and application of appropriate values. The cost of this activity will be financed by the project and the work will be supervised and coordinated by the CWC Hydrology Unit. To facilitate conversion of this data into the applicable flood event, CWC would issue guidelines supported by standardized computer programs, and provide training programs for the state personnel.

3.11 The CWC-Hydrology Organization would also have direct responsibility for estimating the design flood for the 33 dams identified for initial rehabilitation. This work has been scheduled in coordination with the states' evaluation schedules so that revisions to spillway capacities can be incorporated into remedial action plans. The state hydrology personnel would participate in analysis on dams within their state and thus simultaneously receive training. Hydrologic analysis would ultimately be performed at the state level with the CWC Hydrology Organization responsible for vetting the results. Assurances were obtained that CWC would perform the design flood hydrology estimates on the 33 dams presently identified and would review and approve all design flood hydrology estimates prepared by the states or any other agency.

3.12 Expansion of Flood Forecasting Network (US\$8.9 million, 4.5% of base costs, Annex 7). Interstate river basins within the participating states will be evaluated for the potential to be brought into the national flood forecasting network, (candidate basins include the Chambal, Krishna, and Mahanadi). The project would provide equipment to monitor and predict river flow and stage at important sites, communications facilities for distributing information to the

riparian states, data processing and analysis equipment. Timely warning of impending floods is of major assistance in moderating their impact, and these facilities would contribute significantly to the safety of structures and reduction of risks to the population threatened by flood flows.

#### Detailed Features - Participating States

3.13 Institutional Strengthening (US\$8.9 million, 4.5% of base cost, Annex 2). Safety operations in the participating states would be strengthened. The existing State Dam Safety Organizations (SDSOs) would be expanded to meet the required regularity and intensity of inspections and technical investigations. This will require extra staff (about 175 in total) and upgraded equipment and facilities in all four states. Assurances have been received from the participating states that they would inspect dams in accordance with procedures set out by CWC guidelines and adopted by the National Committee on Dam Safety. The states have assured that they would staff and equip their Dam Safety Organizations sufficiently to meet these requirements and that by August 31, 1996, all incremental staff positions in the SDSO being funded by the project would be made permanent establishment positions.

3.14 State Dam Safety Committee. The dam safety assurance program of each state requires high level overview. To carry out this function, State Dam Safety Committees would be established. The Secretary Irrigation, or the Engineer-in-Chief would be the chairman of the committee, and the head of the SDSO would be member-secretary. Other Chief Engineers of the Irrigation Department would be members of the committee (see The Organizational chart in Annex 1). While the committee is made up of existing personnel, new staff will be required in the state engineering organizations to make the hydrologic and structural analysis and prepare the designs for the remedial action contracts. Each participating state has established a Dam Safety Committee, by government order.

3.15 Basic Facilities (US\$24.4 million, 12.4% of base cost, Annex 3). A variety of facilities and equipment are required to provide safety assurance during operation of a dam, particularly where spillway gates must be operated by on-site personnel during floods. The project would provide: (a) communications equipment to warn site operators of impending floods or civil authorities of high releases; (b) all-weather roads to allow site access at all times; (c) backup power supplies to operate gates and other facilities in times of disruption of the normal power supply; and (d) basic instrumentation for monitoring the behavior or performance of the dam and to measure water quality.

3.16 Remedial Works (US\$126.9 million, 64.5% of base cost, Annex 5). The project would support the investigation, design and construction activities for remedial works at selected dams. A total of 33 dams in the participating states have already been identified and categorized by the participating states to receive remedial action. In some cases additional investigations are required to complete the evaluation and analysis. After the full evaluations have been completed the proposed remedial action plan will be placed before the states' Dam Safety Review Panel (DSRP--see para 3.18) for concurrence of the approach, the analysis and solutions proposed before any remedial work is cleared for construction.

3.17 Assurances were obtained that during project implementation, procedures would be established by the states for prioritizing of dams for inspections, initially inspecting all large dams and then making re-inspection every five years, conducting follow-on investigations, selecting and prioritizing those requiring remedial works and obtaining approval from the DSRP of the remedial action plans. As dams in need of remedial works are identified under this process they will be evaluated against the 33 dams already identified to select the final dams to be funded under the project. CWC would assure that such procedures are followed. Assurances were obtained from the participating states that senior design staff associated with formulating the remedial works designs would participate regularly in field supervision of construction activities and advise on quality assurance measures during the construction phase of each sub-project.

3.18 Each state has also established a Dam Safety Review Panel (Annex 6), comprising experts from various disciplines (typically hydrology, foundation engineering, geology and dam design) who would provide independent technical review of the safety aspects of remedial works. The committees will function under terms of reference satisfactory to the Bank. Each participating state has established a Dam Safety Review Panel to operate under the Terms of Reference jointly agreed to by the National Committee on Dam Safety and the Bank (see Annex 6). Assurances were obtained at negotiations that the participating states would maintain such panels with composition and terms of reference satisfactory to the Bank, during the project period.

Project Implementation, Organization and Management

3.19 Central Government. The CWC-DSO would be responsible for:

- (a) coordination of project activities, monitoring and reporting progress;
- (b) ensuring that proposals for remedial works have been processed by the states in accordance with procedures agreed under the project, through the State Dam Safety Organizations, State Dam Safety Committees, and Dam Safety Review Panels;
- (c) training of SDSO staff in standard procedures of dam inspection and dam assurance programs;
- (d) developing and disseminating to the states a computer simulation model for training dam operators in operation of gated spillways during flood events; and
- (e) developing and disseminating guidelines and procedures relating to dam safety.

3.20 The CWC-Hydrology Organization would be responsible for:

- (a) supervising preparation of the design precipitation atlases (see paras 3.9 and 3.10);

- (b) directing state technical personnel seconded to the CWC headquarters during flood hydrology analysis;
- (c) training state hydrology staff in use of the standardized precipitation atlases and associated computer software to estimate related floods; and
- (d) vetting all flood hydrology analysis made directly by participating states.

3.21 The CWC River Management Wing may be required to assist the design, procurement and operation for the flood forecasting operation systems.

3.22 State Governments. The State Dam Safety Committees (SDSC, para 3.14) would oversee the dam safety assurance program at the state level, and be responsible for:

- (a) establishing priorities;
- (b) ensuring that responsible government officers are aware of problems as they emerge; and
- (c) formulating budgetary requirements for investigations and construction, arranging for and supervising construction of remedial works, and allocating available funds.

3.23 State Dam Safety Organizations (para 3.13) would have primary responsibility for carrying out the program of safety assurance. The SDSO would:

- (a) collate and analyze bi-annual inspection reports from field operation and maintenance staff, and prepare a report summarizing this information;
- (b) make a ranking by hazard (highest to lowest), of all large dams in the state and use that ranking to prepare a schedule of inspections;
- (c) carry out regular field inspections to assess the safety status of all large dams in the state;
- (d) oversee full 5-year reinspection (Phase I) and reassessment of the safety status of large dams in the state;
- (e) oversee detailed field analysis of structures with identified problems, using their own staff, staff from the Irrigation Department, or outside consultants as required;
- (f) identify dams requiring detailed investigations and remedial action and advise the State Dam Safety Committee; and
- (g) maintain a record and data base on each dam in the state in respect to pertinent dam safety information.

3.24 The investigations, design, procurement and implementation of remedial works would be the responsibility of the state Irrigation Departments, and executed either by consultants or line departments. The Dam Safety Review Panels (para 3.18) would review the technical analysis, designs and field execution of remedial works. Remedial works are extremely site specific, requiring on-site response to conditions observed during construction and therefore the design staff will be required to actively participate in the construction supervision.

3.25 Assurances were given during negotiations that there would be a mid-term review and assessment of project implementation progress and performance held between CWC, representatives of each state, and the Association, just prior to the end of the third year of the project. The review will have particular emphasis on the process established under the project for inspection and investigation of dams, selection of dams for remedial works, formulation and implementation of remedial action plans, training programs, and the functioning of the respective roles of the SDSO, the states' Dam Safety Committees and their DSRP.

#### Monitoring and Evaluation (Annex 10)

3.26 An existing, nationwide reporting procedure requires the CWC to assemble information on the safety status of all dams in the country and to summarize ongoing activities of the states. Under the project, in the participating states, an information system with common format would be introduced to record the frequency and findings of inspections and evaluations, numbers of dams requiring treatment, type of treatment, and number with remedial works underway. CWC would combine the information from participating states with other states to prepare the Annual Report on Dam Safety.

3.27 As a result of monitoring information from the project, CWC will be able to assess more broadly common sources of problems (designs practices, technical assumptions, materials used, etc). These assessments would form the basis of projections for future action programs and funding requirements for dam safety as well as evaluation of existing practices in safety assurance, planning, design and construction.

#### Environmental Impact (Annex 9)

3.28 The reduced risk of a dam failure would be a strongly positive environmental impact of the project. In a limited number of cases, changes in the size or location of spillways, permissible flood lift during severe storms, and changes in release patterns during construction may have negative local effects. Typically, these effects would only occur during periods of extreme climatic conditions or for very brief periods, and would be minor in relation to the impact of such natural events. However, in a limited number of cases an environmental impact assessment will be performed to identify mitigating measures as required. Assurances were obtained from participating states that (a) project reports would identify any environmental impact of project works, such as the impacts from a construction activity or the expansion of a submerged area resulting from a reservoir enlargement, and (b) where such changes are expected to occur, the states would prepare an environmental impact assessment indicating mitigating measures to be taken and setting out a time table for implementing such mitigation measures.

Operation and Maintenance, and Cost Recovery

3.29 Under the project, the SDSO would review the bi-annual inspection reports prepared by the field operation and maintenance staff for each dam, and evaluate the adequacy of operation and maintenance. Assurances were obtained from the participating states that adequate funds to deal with maintenance requirements of dams receiving remedial action would be made available to the agency responsible for dam maintenance. No specific cost recovery measures would be introduced under the project.

Status of Preparation and Implementation Schedule

3.30 Of the 33 dams planned to receive remedial works under the project, seven are in a more advanced stage of preparation of final designs and procurement documents. Five sub-projects are in a moderately ready state of investigation and final evaluation, while the remaining 21 have significant technical analysis, designs, and preparatory work to be performed. In all cases, the plans for the sub-projects must be reviewed by the DSRP before being ready for contracting for construction. Basic safety facilities will be procured early in the project period. Annex 5 provides a tabulation of the dams by degree of readiness and Annex 13 shows the planned Implementation Schedule for the project components.

Project Costs

3.31 Total project costs including physical and price contingencies are estimated at Rs. 4,560 million (US\$196.8 million). Cost estimates are based on July 1990 prices for similar works recently undertaken in the participating states. Physical contingencies of twenty percent have been applied to construction works, and five percent to machinery and equipment. Price contingencies are based on the following projected inflation rates by Indian financial year:

	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Local percent	8.3	6.6	6.5	6.5	6.2	6.2
Foreign percent	3.4	3.4	3.4	3.4	3.4	3.4

The total project cost, net of duties and taxes, is US\$189.8 million. Identifiable duties and taxes amount to Rs 163 million (US\$7.0 million). The breakdown of costs by component is summarized in the following table and detailed in Annex 11.

	-----Rs.millions-----			-----US\$millions-----			Foreign	Total
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Exchange</u>	<u>Base</u>
							(%)	(%)
<u>Components</u>								
CWC Institutional Strengthening	48.2	6.0	54.2	2.7	0.3	3.0	11.0	1.7
Flood Forecasting Networks	93.7	67.2	161.0	5.2	3.7	8.9	41.8	5.2
State Institutional Strengthening	137.4	23.0	160.4	7.6	1.3	8.9	14.4	5.2
States Basic Safety Facility	338.5	100.1	438.8	18.8	5.6	24.4	22.8	14.2
States Remedial Works	2104.6	179.2	2283.9	116.9	10.0	126.9	7.8	73.7
Total Base Cost	2722.4	375.6	3098.0	151.2	20.9	172.1	12.1	100.0
Physical Contingencies	451.3	54.6	505.8	25.1	3.0	28.1	10.8	16.3
Price Contingencies	<u>778.7</u>	<u>177.7</u>	<u>956.1</u>	<u>-5.9</u>	<u>2.5</u>	<u>-3.4</u>	<u>0.0</u>	<u>0.0</u>
Total Project costs	3952.4	607.5	4559.9	170.4	26.4	196.8	13.4	114.3

Financing Plan

3.32 Total project costs of US\$196.8 million, including contingencies duties and taxes, would be financed as follows:

Category	------(US\$ millions)-----			
	States	GOI	Bank	Total
Land Acquisition	0.2	0.0	0.0	0.2
Civil Works	14.0	0.3	128.6	142.9
Equipment and Vehicles	1.3	3.6	13.7	18.6
Training, Technical Assistance and Consultants	0.0	0.0	6.0	6.0
Design, Supervision and Administration	16.2	0.3	0.0	16.5
Incremental Staffing	1.3	0.4	4.7	6.4
Recurrent Incremental Operating Costs	<u>5.3</u>	<u>0.9</u>	<u>0.0</u>	<u>6.2</u>
Total Project Cost	38.3	5.5	153.0	196.8

3.33 GOI would on-lend loan/credit proceeds to state governments, under standard arrangements for developmental assistance to the states. The IDA Credit and Bank loan of US\$153 million would finance about 81% of total project costs (net of taxes and duties), including 95% of the foreign exchange costs equivalent to US\$25.2 million. The IDA Credit and the Bank Loan would be made to GOI on standard terms and conditions. The states' contribution of US\$38.3 million would be included in their normal budgetary allocations for project activities. Funds for implementing the institutional strengthening, basic facilities and remedial works for each state would be channeled through the Irrigation Departments of each participating state. Incremental costs for sustaining activities established under the project following its completion would be met by the individual states from its budgetary sources or by special fees from the beneficiaries of the benefits incurred as a result of this project. Financial provisions to be made by the States are consistent with budgetary allocations for the project period.

Procurement

3.34 Procurement arrangements are summarized in the following; figures in parentheses indicate amounts to be financed by the Bank.

(US\$ millions)

Project Element	Procurement Method				TOTAL COST
	ICB	LCB	OTHER 1/	NA	
Land Acquisition	-	-	-	0.2 (0.0)	0.2 (0.0)
Works	-	132.9 (119.6)	10.0 (9.0)	-	142.9 (128.6)
Equipment and Vehicles	7.7 (3.6)	7.4 (6.9)	3.5 (3.2)	-	18.6 (13.7)
Training, Technical Assistance and Consultants	-	-	6.0 (6.0)	-	6.0 (6.0)
Design, Supervision and Administration	-	-	-	16.5 (0.0)	16.5 (0.0)
Incremental Staff Salaries	-	-	-	6.4 (4.7)	6.4 (4.7)
Recurrent Incremental Operating Costs	-	-	-	6.2 (0.0)	6.2 (0.0)
TOTAL	7.7 (3.6)	140.3 (126.5)	19.5 (18.2)	29.3 ( 4.7)	196.8 (153.0)

1/ "Other" includes force account, local shopping and the Bank's selection of consultants' procedures.

3.35 Civil Works. Works to be financed under the project would cost about US\$141 million excluding design engineering, construction supervision, administration, and the cost of land. Most of the contracts will require flexible construction schedules to meet existing dam and reservoir operations.

The work will generally be packaged in specialty contracts and may require multiple contracts for work at each dam, sometimes mixed with force account work. Such works will rarely be suited to International Competitive Bidding. For the purpose of bidding, civil works can be grouped as follows:

- (a) ICB procedures would be used in the event that any single contract is estimated to be US\$10 million or more. While no ICB civil works contract is presently expected, if one occurred local bidders would be granted a preference of 7.5%.
- (b) LCB Contracts (US\$133 million) would be based on a standard document approved by the Bank. General rate contracts will not be acceptable as a substitute of LCB procedures. Prequalification procedures would be used for all contracts valued at US\$2 million or more. Foreign firms will be allowed to bid on LCB civil works contracts.
- (c) Force account and Unit Price Contracts (US\$10 million) would be limited to an amount less than US\$200,000 each and the aggregate of all such contracts would be less than US\$10 million.
- (d) Existing state procurement procedures (called here, simplified local bidding procedures) may also be used for contracts less than US\$200,000 provided the contracting procedure is reviewed and acceptable to the Bank and standard bidding documents are agreed to.

3.36 Equipment and Vehicles. Items costing less than US\$20,000 would be procured through local shopping procedures acceptable to the Bank, up to an aggregate value of US\$2 million. The main components of the flood forecasting communication system are not available in-country and will be procured through ICB. Packages of US\$200,000 or more will be ICB and those less than that will be the LCB. Except for the communications system equipment, local firms may be competitive under ICB. Local bidders competing under ICB will be granted a preference of 15% or the custom duties and import taxes, whichever is the least. Foreign firms will be allowed to bid on LCB contracts. Standard bidding documents for ICB and LCB acceptable to the Bank would be agreed by the date of effectiveness for use on the project.

3.37 Employment of Consultants. All consultant services (estimated at US\$6 million) would be obtained on terms and conditions satisfactory to the Bank according to the "Guidelines for the Use Of Consultants by World Bank Borrowers and the World Bank as Executing Agency" published by the Bank in August 1981.

3.38 Contract Review. All bidding packages and bid evaluation reports for civil works estimated to cost US\$200,000 or more equivalent, covering about 70% of works contracts, for equipment and vehicles estimated to cost US\$100,000 or more equivalent, for all ICB contracts, and for contracts for consultant services would be subject to Bank's prior review. The remaining contracts would be subject to post review.

3.39 Procurement of works, goods or services for retroactive financing will comply with the above provisions and where applicable will be subject to Bank review and clearance prior to contracting.

### Disbursements and Financial Arrangements

3.40 Disbursements are projected over a period of six years. Project completion is expected by March 31, 1997 and Loan/Credit closing by September 30, 1997. Retroactive financing up to a total of SDR 7.4 million (US\$10 Million) is provided to cover eligible project expenditures incurred before signing but after November 30, 1990, the arrival date of the Bank appraisal mission. The proceeds of the Loan/Credit would be disbursed against the following:

- (a) 90% of expenditures against civil works;
- (b) 100% of foreign expenditures or 100% of ex-factory costs or 80% of other local costs of equipment and vehicles;
- (c) a percentage of the expenditures for incremental staff salaries for institutional strengthening on a declining basis starting at 90% until July 31, 1993, thereafter at 75% until July 31, 1995 and thereafter at 60% until the end of the project; and
- (d) 100% of expenditures against training and consultants.

3.41 To facilitate disbursements, a Special Account would be established in the Reserve Bank of India with an initial deposit of US\$8 million, equal to about four months estimated average expenditures from which project expenditures would be reimbursed. Disbursements against (a) civil works contracts of less than US\$200,000, (b) equipment, vehicles, consulting services and training contracts of less than US\$100,000, and (c) incremental salaries would be made against Statements of Expenditures (SOEs). All other payments would be made against full documentation. Annex 12 shows the estimated schedule of disbursements in six month increments.

3.42 The procedures for preparing the SOEs would be: (a) project expenses would be summarized monthly by each participating state/agency under expense headings agreed with the Bank and which would be certified by the designated signing authorities; and (b) CWC would collect these which would be appropriately certified and forwarded each month to the Ministry of Finance in GOI for processing and reimbursement from the Special Account. All supporting documentation for the SOEs would be retained by the responsible participating states/agency, and appropriately filed to enable easy access for subsequent review by Bank supervision missions and annual audits. GOI will fully pass on the proceeds of the Loan/Credit, to the participating states in the normal 70:30 (loan:grant) formula in which assistance from the center is passed on to the states, with GOI assuming the foreign exchange risks. In addition, GOI would throughout the life of the project, make available about two months anticipated reimbursable project expenditures in advance to the participating states for the sole use of the project and the participating states would make similar advances to the executive agencies. For its counterpart financing, the participating states will ensure that anticipated project expenditures are properly and adequately included in their annual budget plans.

### Project Accounts, Audits and Reports

3.43 Project expenditures incurred by each participating state/agency (CWC) would be subject to the normal cost accounting procedures and control. The project accounts would be maintained in a form to show: (a) actual versus planned expenditures for each quarter; (b) actual versus planned accumulated expenditures to date; and (c) how financed, showing expenditures financed by the Bank, GOI, and the participating states. Appended to the project accounts would be a listing of the Withdrawal Applications for the period concerned, showing the amounts reimbursed. The project accounting format will be agreed with the Bank prior to project effectiveness.

3.44 The Auditor General of India will be considered the acceptable auditor and the audited project accounts including a separate opinion on SOEs would be submitted annually, to be received by the Bank no later than nine months thereafter. The Auditor General of India would also be the auditor for the Special Account. The Auditor's Report, which would be accompanied by a Summary Statement of the Special Account, would be submitted to be received by the Bank no later than nine months after the end of each fiscal year. The implementing agency (CWC) would prepare a quarterly report on the projects's progress against the plan for each component, with explanations of any delay from the plan and outlining what remedial actions are being taken. The quarterly report will be submitted to the Bank concurrent with unaudited quarterly project accounts. A Project Completion Report would be prepared by CWC within six months of the closing date. Assurances were obtained during negotiations that the above accounting, auditing and reporting procedures would be followed.

### Project Benefits and Justification

3.45 Conventional cost/benefit analysis is not an appropriate measure or criteria for evaluation of this project. The probability of a dam failing (which is small) and the magnitude of the potential benefits (which are extremely large, but difficult to measure in economic terms) are both impossible to define accurately.

3.46 Thus the justification for the project rests on the fact that dam safety assurance is a regulatory function of government, which is undertaken to prescribed standards for the benefit of the general public. The standards to be followed under this project, are essentially those set out by the International Commission on Large Dams, which are generally accepted as applicable in many countries.

### Project Risks

3.47 The project faces no major organizational or technical risks. There is a risk that states will be slow in making funds available for remedial action or in providing the additional staff and facilities to inspect, evaluate and identify remedial actions for the nearly 900 existing large dams within the four states that have yet to be fully evaluated. There is also the risk that the states will not make timely and full redeployment of staff to the permanent roster. The project design has incorporated the necessary staff levels and training to address the action needed for successful implementation.

**IV. AGREEMENTS AND RECOMMENDATIONS**

**4.1 Assurances were obtained at negotiations from the participating states that:**

- (a) they would inspect dams in accordance with procedures established by CWC guidelines adopted by the National Safety Committee on Dams, and would staff and equip their Dam Safety Organizations sufficiently to meet these requirements (para 3.13);**
- (b) by August 31, 1996, the SDSO staff would be made a part of the permanent establishment (para 3.13);**
- (c) during project implementation, procedures would be established by the states for prioritizing of dams for inspections, initially inspecting all large dams and then making re-inspection every five years, conducting follow-on investigations, selecting and prioritizing those requiring remedial works and obtaining approval from the DSRP of the remedial action plans. Dams identified under the inspection process will be evaluated against the 33 dams already identified for the states to select the dams to receive remedial work under the project. CWC would assure that such procedures are followed (para 3.17);**
- (d) senior design staff associated with formulating the remedial works designs would participate regularly in field supervision of construction activities and advise on quality assurance measures during the construction phase of each sub-project (para 3.17);**
- (e) Dam Safety Review Panels would be maintained, with composition and terms of reference satisfactory to the Bank, during the project period (para 3.18);**
- (f) there would be a mid-term review and assessment of project implementation progress and performance held between CWC, representatives of each state, and the Association, just prior to the end of the third year of the project. The review will have particular emphasis on the process established under the project for inspection and investigation of dams, selection of dams for remedial works, formulation and implementation of remedial action plans, training programs, and the functioning of the respective roles of the SDSO, the states' Dam Safety Committees and their DSRP (para 3.25);**
- (g) with respect to environmental effects, project reports would identify any environmental impact of project works, such as the impacts from a construction activity or the expansion of a submerged area resulting from a reservoir enlargement, and where such changes are expected to occur, prepare an environmental impact assessment indicating mitigating measures to be taken (para 3.28);**

- (h) adequate funds to deal with maintenance requirements of dams receiving remedial action would be made available to the agency responsible for dam maintenance (para 3.29);
- (i) project accounts would be maintained in a form to show: (i) actual versus planned expenditures for each quarter; (ii) actual versus planned accumulated expenditures to date; and (iii) how financed, showing expenditures financed by the Bank, GOI, and the participating states (para 3.43); and
- (j) the project accounts and the Special Account would be audited annually by the Auditor General of India and CWC will prepare quarterly reports of progress and unaudited project accounts (para 3.44).

4.2 Assurances were obtained from the GOI that:

- (a) The CWC Hydrology Unit would carry out the design flood analysis for the presently identified 33 dams to receive remedial action; and
- (b) The CWC Hydrology Unit would make a review and give concurrence (vetting) of any flood hydrology analysis made by the states on other dams.

4.3 With the above assurances, the project would be suitable for an IBRD loan of US\$23 million equivalent, for a term of 20 years including 5 years of grace at the Bank's standard variable interest rate, and an IDA credit of SDR 96.2 million (US\$130 million equivalent) on standard terms with 35 years maturity.

INDIA

DAM SAFETY PROJECT

Dam Safety in India

India's Use of Large Dams

1. India has a geographical area of 3.29 million square kilometers. It receives, on an average, annual rainfall of 1,170 mm, which results in a surface run-off of approximately 1,880 km<sup>3</sup>. It is estimated that only about 1,100 km<sup>3</sup> can be beneficially utilized. The primary reason for this is the seasonal disparity of the rainfall and runoff in which about 90% of the average annual run-off of peninsular rivers and 80% of that of Himalayan rivers is available during the monsoon season, i.e., June to September. Therefore, for meeting the year round needs of irrigation, drinking water supply and industries in the country with such vast population, creation of storages across rivers and streams is vital. These storages are created by construction of dams that are frequently categorized by size as simply, large, medium or small dams. It has been estimated that it is feasible to ultimately create a total storage capacity of about 690 km<sup>3</sup> in the country. So far, however, less than 300 km<sup>3</sup> of storage has been created in the India, out of which about 200 km<sup>3</sup> has been provided by large dams. Thus it is obvious that large dams play a very important role in the water resources development of the nation.

2. The International Commission on Large Dams (ICOLD) classifies a large dam as one with a maximum height of more than 15 meters. A dam having between 10 meters and 15 meters maximum height is also included in the classification of a large dam provided its length is not less than 500 meters or capacity is not less than 1 million cubic meters or the maximum flood discharge is not less than 2,000 cubic meters per second.

3. According to the aforesaid classification, India has about 2,900 completed large dams and another 700 under construction. A tabulation of the dams constructed over time is as follows:

<u>Year when dam was completed</u>	<u>Number of Dams</u>
Prior to 1900	40
During 1901 - 1950	210
1951 - 1960	226
1961 - 1970	454
1971 - 1980	1002
1981 - 1989	740
Dates of completion not available	266
<u>Total</u>	<u>2,938</u>

The above table shows that almost 500 large dams in the country are more than 30 years old, with 900 being older than 20 years and 2,000 older than 10 yrs.

4. In India the storage dams are mostly owned, maintained and operated by government agencies, primarily the state governments. The primary use of single purpose dams are those planned and constructed to provide water for irrigation. Many of the large dams however, are multipurpose with hydropower facilities and as the demand in the country for municipal water requirements increase, more and more of the storage is shared for domestic purposes. Some major dams are operated by National, Regional or State Electric Boards.

5. Any public civil works facility such as dams, buildings or bridges present a degree of risk to loss of life or damage to property should it fail. All such structures also have the characteristic to change over time in their adjustment to their surroundings and in their capability to resist the forces imposed upon them by man and nature. Dams, however due to the ever changing conditions of the populations located along the river banks downstream, often constitute a higher hazard in case of failure than other public structures. National governments therefore commonly accept the public role for assuring an acceptable standard for safety of dams. The central governments usually establish the safety standards, monitor the safety status and establish programs that require the owner's to the dam to meet the safety requirements in the public interest. The Government of India has acknowledged and accepted that role in regard to safety of dams and is seeking to become more effective in dam safety assurance. The Dam Safety Project will not guarantee that there will be no future dam failures in the participating States. The project will however provide a significant reduction in the risk of such failures.

#### Creation of India Dam Safety Organizations

6. Although dam safety is considered an inherent function in the design, construction, maintenance and operation activities surrounding dams, it has been reorganized worldwide within the past two decades that dam safety, particularly at existing dams, may not be receiving the concentrated attention that it should considering the number of dams in being, the aging of dams, and the standards and criteria viewed as appropriate under today's technology and knowledge. It has been also generally recognized within the international dam safety community that to achieve a successful dam safety assurance program requires a dedicated institutional structure with access to top management attention. Without top management commitment to providing the necessary resources, the program will be lost amid other demands and more dams will become at risk.

7. With the ever increasing number of dams, the Government of India also realized the importance of dam safety and took a number of steps to reinforce its concern.

8. The first formal recognition of dam safety as an institutional process and concern occurred in July 1975, during the first conference of the State Minister of Irrigation. At that conference, it was recommended that the Government of India should constitute an Advisory Dam Service to be operated by the Central Water Commission (CWC). Accordingly, in June 1979, a Dam

Safety Organization was established within CWC. Its purpose was to assist state governments to locate causes of potential distress and to recommend suitable remedial measures. It primarily functions as a coordinative and advisory body to the States as the office responsible for promulgating guidelines, compiling relevant literature, organizing training and functioning as the Secretariat for the National Dam Safety Committee. The Dam Safety Organization receives requisite technical assistance from other directorates within the CWC.

9. The fifth conference of the State Ministers of Irrigation in November 1980 recommended that the State Governments also constitute dam safety organizations charged with the responsibility for maintaining an inventory of dams, compiling a history to reveal areas requiring special attention and monitoring administrative and technical procedure regarding dam safety. In pursuance of this decision, twelve states having a significant number of dams created dam safety organizations. The staffing levels, capabilities and activities however, vary widely.

10. Appropriate guidelines issued by the CWC in June 1987 were supplied to the states for adoption through the State Dam Safety Organization as distinct from the Maintenance and Operation Organization.

11. A National Committee on Dam Safety, headed by the Chairman of the CWC and with representatives from all states having a significant number of dams, monitors the dam safety activities of the country.

#### Development of Indian Dam Safety Practices and Standards

12. A committee was constituted by GOI in August 1982 to review the existing practices of inspection and maintenance of dams and allied structures in various states and to evolve standard guidelines for the same. The committee's report of August 1986 constitutes the document on 'Dam Safety Procedures' for the country to be followed by the State agencies who own the dams and are principally responsible for their planning, design, construction, operation and maintenance and their safety. The prescribed procedures for Dam Safety, as embodied in the report of the aforesaid committee, are summarized below:

#### Functions of the Dam Safety Cell in the State

Each state which has more than twenty major dams should have a Dam Safety Organization (DSO) to be headed by an officer not below the rank of a Superintending Engineer. The DSO should include a hydrology unit which would undertake the review of inflow design flood after establishing priorities. The cell may consist of one expert on the design of concrete and masonry dams and another expert on earth or rockfill dams with supporting technical staff. One of them should have a good geotechnical background. An identified field officer from Geological Survey of India should be

associated with the DSO.

A. Primary Functions of the State Dam Safety Cell

- (a) Only large dams as per ICOLD definition to be under the purview of the DSO.
- (b) Technical documentation should be compiled and records maintained.
- (c) Each state should issue an executive order for inspection, maintenance and surveillance of dams. The DSO will monitor implementation.
- (d) Arrange safety review of dams which are more than 15 meters in height or which store 60 million cubic meters (50,000 acre feet) or more, by an independent panel of experts once in 10 years.
- (e) Arrange for review of spillway capacity of the existing dams and for the necessary remedial action wherever needed.
- (f) Monitor pre and post-monsoon inspections and review the irrigation reports for abnormalities.
- (g) In case of a problem with a dam, on the request of the Chief Engineer in-charge of the dam, officers of the DSO should visit the dam to offer appropriate advice on remedial measures. If the problem is complicated, the DSO should write to the Secretary to Government to constitute a panel to review the problem and to identify the cause and to suggest remedial measures. It is envisaged that the panel should consist of (i) an experienced dam engineer having background of design and construction; (ii) the Chief Engineer D.S.O. of CWC; (iii) the Project Chief Engineer; and (iv) the Head of State Dam Safety Cell, as member Secretary. The panel should have powers to co-opt any expert considered necessary.
- (h) Compile statistics concerning failures. Prepare the first information report of any failure which should also initiate action for constituting a committee to review the causes of failure.
- (i) Act as a data bank with respect to dam safety and make random checks of the data received from the Engineer in-charge of the project to ensure its correctness by making site visits.
- (j) Prepare a program of review of safety of dams in the state

both from hydrological and structural considerations. The committee's report prescribes detailed guidelines for fixing priorities for safety reviews and has directed that the hazard potential of the dam should also be taken into account while fixing priorities for safety reviews.

- B. Apart from the procedures prescribed regarding the administrative set up of the DSO and its functions as summarized in para 2.0, the committee has prescribed, in its report, detailed guidelines on the following issues also:
- (a) hydrological safety of existing dams;
  - (b) structural review including seismological review;
  - (c) guidelines for inspection, operation and maintenance; and
  - (d) emergency preparedness plans.

13. While the procedures laid down by the committee mainly relate to the existing dams, the report also includes brief directions regarding safety assurance in respect to new dams, including the need to establish independent Dam Safety Panels for such dams and to advise the project authorities in all phases of dam building activity.

#### Guidelines for Inspection of Dams

14. In addition to the Dam Safety Procedures' prescribed by GOI committee's report of August 1986, the Dam Safety Organization of CWC have issued "Guidelines for Safety Inspection of Dams in June 1987. These guidelines are for adoption by the states and have been issued by DSO CWC in pursuance of the recommendations of the Conference of State Ministers of Irrigation and assignment of this function to the DSO constituted in CWC in June 1979. These guidelines apply to the inspection and evaluation of all dams/barriers together with appurtenant works which impound or divert water and which (1) are 8 m or more in height or (2) have an impounding capacity of 6 ha m or more. Barriers which are 2 m or less in height regardless of storage capacity or barriers which have a storage capacity at maximum storage elevation of 2 ha m or less regardless of height are exempt from these guidelines.

15. These guidelines closely parallel those used by the US Army Corps of Engineers in implementing the National Program for Inspection of non-Federal dams in the United States and reflect the philosophy of the International Commission on Large Dams (ICOLD). The guidelines as issued are considered thoroughly adequate for the purpose. As periodic inspections are the centerpiece of any effective and successful Dam Safety Assurance Program, it was recommended and accepted by CWC in formulating this project that dam inspections be conducted at 5-year intervals rather than 10 years as conditions will change because of deterioration and other factors.

16. The guidelines consist of a two-phase inspection and investigation program. Phase I is an inspection to assess the general conditions of a dam and to determine the need for any additional engineering investigation and analyses, including hydrological. It consists of a visual examination of the dam and a review of available engineering data, including operating records. Costly and extensive exploration or analyses are not intended.

17. Phase II investigations are performed where the results of the Phase I inspection indicate the need for additional investigations and studies. It includes, as required, all additional visual examinations, measurements, foundation exploration and testing, materials testing, hydrologic and hydraulic analysis and structural stability analyses (including seismic) deemed essential to fully evaluate the safety of the dam.

18. The guideline contains further details explaining the content and extent of each of the features noted in the preceding two paragraphs, plus providing suggested report formats and a checklist for field inspections.

#### Conception and Formulation of a Dam Safety Assurance Project

19. Although the conceptual framework was laid and guidelines were available, some institutional strengthening was achieved, some inspections were performed and some remedial work accomplished, the tempo of dam safety activity in India has not kept pace with the needs and a backlog of potential risk has accumulated. A lower priority being afforded maintenance and surveillance of existing dams can be attributed to several factors : a lack of constitutional authority and/or legislation for the Central Water Commission to enforce a national program of dam safety assurance, an inherent aversion to admitting that some dams may be at risk, the attention of state organizations being diverted to constructing new dams, and perhaps most importantly, a lack of funding and dedicated staff to satisfy the needs of maintaining an active, viable dam safety assurance program.

20. Maintenance and upkeep of the dams has been always been recognized as an important activity and almost all the state government agencies responsible for this activity have had determined their own norms and procedures of surveillance of dams through some type of annual inspection and reporting procedure. In most states, budget allocations are made for maintenance of irrigation projects (including dams) on the basis of a set amount for each hectare under the project command area. This type of budgeting procedure is frequently not equitable for either the dam or the canals and distribution system. As a result of annual inspection, routine repairs are carried out within the limits of the budget allocations. However, with the increase of state irrigation developmental activities with emphasis on creation of new potentials by constructing new dams, it has been a common situation that the surveillance and maintenance of existing dams started getting lower priority in all aspects of attention, resources and funds.

21. In the late seventies and early eighties the concern regarding proper dam surveillance to ensure safety was recognized at the national level and the creation of the Dam Safety Organization at the central level in Central

Water Commission was followed by establishing similar organizations in most of the states during the mid eighties. Thus, a foundation was laid for a nation-wide and systematic dam surveillance program. However, the paucity of resources in the non-Plan sector has been one of the reasons coming in the way of making the activity effective. GOI and the Ministry of Water Resources, having recognized the situation, decided that a Dam Safety Assurance Program, including strengthening of the organizations involved and carrying out rehabilitation of dams with deficiencies was required and should become a part of the planned activity from India's Eighth Five Year Plan.

22. The World Bank has been extensively involved in water resources development projects in India over the last two decades and has thereby been associated with funding assistance on projects involving approximately 150 large dams in India. As a result, there has been extensive dialogue between the Bank, central agencies and various state authorities on the scope and responsibilities for dam safety in relation to specific Bank funded projects. Following a CWC-sponsored Dam Safety Workshop (March 1988) in which the Bank participated along with representatives of several states, a joint Bank/CWC/state team visited India. This mission set out a framework for state level dam safety organizations. This framework has been accepted by the central government, which is now advocating its adoption by other states.

23. At a meeting of the state representatives of the National Dam Safety Committee held in conjunction with a dam safety seminar in Nasik in 1989, concepts of having a World Bank funded project was generally outlined. Since the dams are mostly owned by the state governments, they were requested by GOI to indicate their views on participation in such a project which would include strengthening the Dam Safety Organizations in both CWC and the states. In addition to setting in motion a more rigorous and regular schedule for safety inspections and evaluations, it was proposed that funding also be made available to carry out remedial action on some of the dams known to be needing immediate attention. As a result of these deliberations four states, Madhya Pradesh, Rajasthan, Orissa and Tamil Nadu along with CWC (DSO) agreed to initiate the identification reports to formulate the Dam Safety Project. Other states have expressed interest in participating but have not fully developed their requirements for staffing or rehabilitation. It is expected that another group of states may be ready to undertake similar actions within the next couple of years.

24. Since this project is to deal for the present with four states only, it is appropriate to indicate here the number of completed dams in each state and the period during which these were constructed.

<u>State</u>	<u>Total number of large dams (completed)</u>	<u>Time of Completion</u>					
		<u>Prior to 1900</u>	<u>1901 1950</u>	<u>1951 1960</u>	<u>1961 1970</u>	<u>1971 1980</u>	<u>1981 1989</u>
Madhya Pradesh	608	2	113	38	83	165	207
Rajasthan	124	7	32	30	19	18	18
Orissa	131	-	3	3	5	48	72
Tamil Nadu	84	1	13	10	24	27	9
<b>Total</b>	<b>947</b>	<b>10</b>	<b>161</b>	<b>81</b>	<b>131</b>	<b>258</b>	<b>306</b>

25. One of the key purposes of the proposed project is to set in motion a means for India of achieving parity for international standards of dam safety by strengthening the institutional process. To upgrade the Dam Safety Assurance Program to present day standards and approaches, the roles, responsibilities and function of both the Central Water Commission and the States needed to be further amplified. During the preparation of the project the CWC-Dam Safety Organization, state representatives, the World Bank staff and World Bank consultants set out some guidelines for the actions and responsibilities, in addition to those presented in India Dam Safety Procedures. These are presented for reference in implementing the Dam Safety Project as follows:

Central Water Commission (CWC) - Actions and Responsibilities

26. The Central Water Commission is responsible for maintaining a Dam Safety Organization adequately staffed and equipped to ensure effective implementation of the Dam Safety Assurance Program on the basis of guidelines approved by the National Committee on Dam Safety. The functions of the Dam Safety Organizations are:

- Acting as Secretariat to the National Committee on Dam Safety,
- Compiling the Annual Report on Dam Safety for the National Committee, based on reports from the states, including specific reference to interstate dams.
- Maintaining a National Register of Large Dams
- Monitoring and reviewing status reports on dams prepared by the states
- Technical overview of remedial works proposed for selected dams
- Arranging training, study tours, workshops and seminars on dam safety

- Monitoring and reporting on progress of dam safety activities under execution in the states.

27. The CWC is responsible for issuing and updating guidelines and standards for use by the States to include, but not limited to:

Pre-and Post-Monsoon inspections  
Phase I Inspections  
Phase II Investigations  
Reporting requirements and formats  
Selection and application of PMP/SPS, and determination PMF/SPF  
Selection of earthquake parameters  
Hydrological risk analysis  
Dam break analysis  
Emergency action plans

28. The CWC is to provide, at the request of the States or the National Committee, consultancy services in hydrology analysis, foundation engineering, instrumentation, dam break analysis and other safety related areas for specific dams.

29. The CWC will expand and maintain a network at Flood Forecasting Stations to provide information to the States for operation of dams during flood events.

30. In the case of interstate dams, CWC is to provide at the request of any party-state advice and guidance on dam safety.

31. The CWC is to arrange training, study tours, workshops and seminars on dams safety and to provide a forum for discussion and information sharing on dam safety.

#### State Governments-Actions and Responsibilities

32. The state shall create a single purpose Dam Safety Organization adequately staffed and equipped to ensure effective implementation of the Dam Safety Assurance Program on the basis of guidelines issued by the Central Water Commission. The functions, the State Dam Safety Organizations are:

- Follow up action on the Executive Orders of the State in relation to dam safety.
- Arranging compilation of Data Books as per the format suggested by the National Committee, and to serve as a Data Bank for all technical documents related to investigations, design, construction, operation, maintenance and safety reviews/inspections for each dam.
- Monitoring and reviewing periodical pre- and post-monsoon inspection reports prepared by the Field Officers. Based on these reports, DSO would prepare status reports on the dams to be forwarded directly to the

Secretary Irrigation, State Dam Safety Committee and Chief Engineers concerned. The Report would contain the following statements:

- |                |  |
|----------------|--|
| Statement No.1 | Dams with Major Deficiencies<br>(Name of dam, nature of deficiencies)        |
| Statement No.2 | Dams with minor rectifiable defects<br>(Name of dam, nature of deficiencies) |
| Statement No.3 | Dams where no deficiency has been reported<br>(Name of dam)                  |
| Statement No.4 | Dams for which report not received<br>(Name of dam)                          |

The Status Reports compiled by the DSO should be issued by the following dates:

October: Pre-monsoon status report  
April: Post-monsoon status report

- To conduct and lead Phase I safety inspections of all large dams, by a multi-disciplinary team comprised of DSO and/or other technical specialists, once every five years, and recommend follow up actions as necessary.
- To organize Phase II safety investigations of dams in accordance with the priorities set by State Dam Safety Committee.
- To monitor adequacy of design review and of quality control organization for large dams under design/construction.
- To monitor and report the status of preparation of completion reports of all project with large dams, including technical reports of design and construction, design memoranda, and the data on which designs were based.
- To monitor and report the status of preparation of operation and maintenance manuals, designers operating criteria and standing operational procedures including Emergency Action Plans for all large dams.
- To monitor and report the status of compilation and analysis of instrumentation data for large dams.
- To prepare annual reports for submission to CWC Dam Safety Organization of the status of health of large dams in the state.
- To guide and ensure preparation of Emergency Action Plans made by the operating agency.
- In case of major distress in dams, DSO should assist project authorities, and expedite formation of a panel of experts; act as secretariat to such panel; coordinate studies/investigations as suggested by the panel; and assist in preparing the panel report.

- In case of failure/accident to a dam, to inspect and prepare a preliminary report on the event.
- Arrange for training courses in dam safety for state agencies and DSO to include procedures for surveillance, inspection, quality control, maintenance, operation, and preparation of emergency action plans, etc.

33. The State shall issue executive orders for pre and post monsoon inspections, operation and maintenance, periodical inspections, safety reviews and surveillance of dams in the state. Such orders shall specify the responsibilities of State agencies with respect to dam safety.

34. The State shall establish a Dam Safety Committee to establish priorities for safety works on the basis of information provided by the State Dam Safety Organization. The composition and role of the State Dam Safety Committee follows:

- (a) The State Dam Safety Committee shall comprise appropriate Chief Engineers of the State and may include other experts (for example from CWC, GSI, academic or technical institutions) as decided by the State. The Committee shall be chaired by the Secretary, Irrigation or Engineer-in-Chief. The head of the DSO will be Member-Secretary of the Committee.
- (b) The State Dam Safety Committee shall:
  - review the work done by the Dam Safety Organization (DSO);
  - review the DSO's report of progress on actions recommended in relation to dam safety;
  - establish priorities for Phase II investigations, and assign responsibilities for execution including: the use of non-departmental resources, and need for the association of independent experts with Phase II investigations;
  - establish priorities among projects needing remedial safety works; and
  - keep the State Government informed of its activities and recommendations.
- (c) The Committee shall meet at least once in six months, but meetings may be called as deemed necessary by the Chairman, or the Member-Secretary.

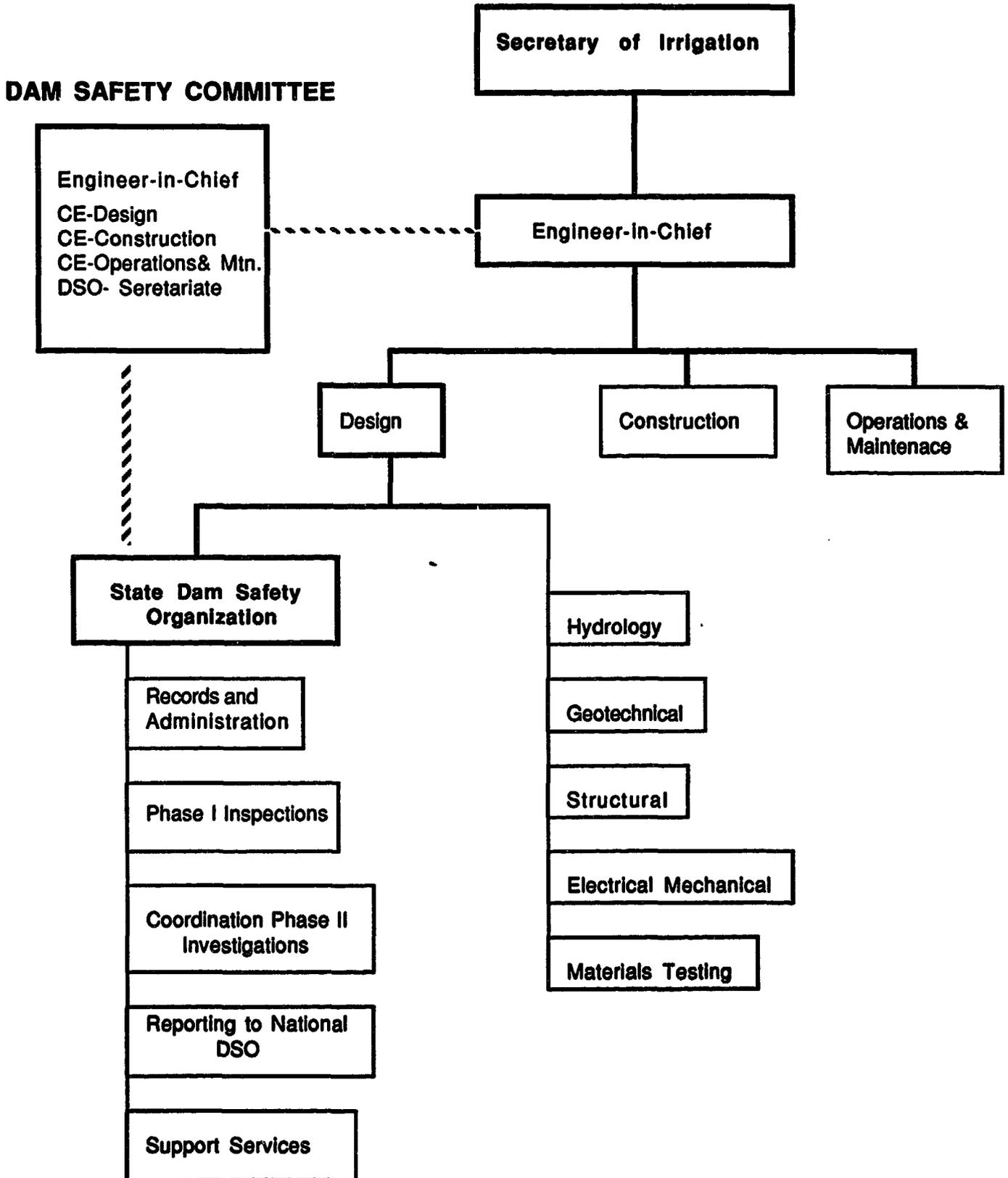
36. The most ideal organizational structure for focussing the necessary top management attention and commitment to dam safety would have the separate and dedicated Dam Safety Organization reporting directly to the level of management with decision-making authority relative to resources (manpower and money) and responsibility for technical adequacy. In most states, this would

be Engineer-in-Chief. However, considering the existing organizational structure and authorities, the need for efficient utilization of manpower and other personnel factors, having the Dam Safety Organization at a level comparable to other Chief Engineers in the State would be infeasible. Absent that option, the next best location for the Dam Safety Organization is within the design unit. To ensure that the Engineer-in-Chief is duly involved as well as the other Chief Engineers having responsibility for some facet of dams, a Dam Safety Committee composed of such individuals is an appropriate vehicle for achieving the commitment and coordination necessary to the efficacious functioning of the Dam Safety Organization. The Committee will be the decision-making body to act on the recommendations of the Dam Safety Organization.

37. The following is an organizational chart for the state level dam safety program participants.

**INDIA**  
**DAM SAFETY PROJECT**

**TYPICAL STATE ORGANIZATION RELATING TO DAM SAFETY**



INDIA

DAM SAFETY PROJECT

Institutional Strengthening of Dam Safety Organizations

1. The Dam Safety Project aims at upgrading institutions and the current standards for dam safety inspection and review, and proposes to modify the role of State Dam Safety Cells/Organizations. Many of the State Dam Safety Organizations (SDSO) are presently only monitoring the annual/biannual dam safety inspection carried out by the on-site project O & M personnel. In the future the SDSO would carry out the dam safety inspection of all large dams in the state by proper prioritization in a fixed time frame, in addition to the other responsibilities already entrusted to these organizations. Details of the proposed revised role of SDSO under Dam Safety Assurances and Rehabilitation (DSAR) project are given in Annex 1. With the increased interest and activity generated by this Project, a greater degree of involvement by CWC Dam Safety Organization (CWC-DSO) will be required to achieve some degree of uniformity in implementation of the dam safety program being set up under this project. In addition, at the request of the State and the National Committee, CWC will also provide consultancy services in hydrologic analysis, foundation engineering, instrumentation, dam break analysis and other safety related areas for specific dams. CWC-DSO will play an effective role in imparting training in dam safety to the state personnel involved in Dam Safety activities. Details of the proposed revised role of CWC in the project are also given in Annex 1 and the training activities are summarized in Annex 8.

2. In view of the increased responsibilities of the Dam Safety Organization both at the CWC and State level, these organisations are required to be institutionally strengthened and the present staff augmented. Since the increased tempo of dam safety activity would also generate additional work related to Hydrology and Designs, it would be necessary to strengthen these connected units (especially Hydrology) both in CWC and States to cater to dam safety related work on a timely basis. The paragraphs that follow lay down the proposals for augmentation of staff at the Center and in the States for the Dam Safety Assurance and Rehabilitation Program.

Institutional Strengthening of Central Water Commission

3. To ensure satisfactory discharge of its responsibilities related to this project, provision has been made for adding three directorates to CWC. These are a Monitoring Directorate, a Special Analysis Directorate and a Rehabilitation Directorate, under the present Chief Engineer DSO. At present the CE-DSO has, under him, in addition to the Dam Safety Directorate, two other directorates, namely, Instrumentation Directorate and Foundation

Engineering Directorate. These last named two directorates basically perform design related activity that can and should be transferred under the respective Chief Engineers Designs in CWC so that the Chief Engineer-DSO would have only four directorates under him, i.e. one existing, and three proposed to be added, to enable CE-DSO to exclusively look after the dam safety program.

4. The functions of the Monitoring Directorate are to monitor the implementation of the program through visits to the states, to review the annual state reports on the status of dam safety, to prepare an annual national report evaluating the effectiveness of the programs and to monitor state safety inspection reports to assure that effective procedures are being followed.

5. The functions of the Special Analysis Directorate are to seek, review and promulgate new technology related to dam safety, to formulate necessary training and to develop and provide specialized expertise to the states in those areas where maintaining the expertise at state level is not warranted. Examples of the type of special analysis anticipated are in dam break analysis, risk analysis and emergency action plans. The dam break analysis is the basis for developing inundation maps which are a vital part of emergency action plans. Emergency action plans containing a warning and evacuation sub-plan are eventually required for every dam, not just those with known spillway deficiencies.

6. The functions of the Rehabilitation Directorate are to coordinate with State activities on preparing remedial action plans and to attend the meetings of the various Dam Safety Review Panels (DSRP) where necessary, to assure their proper functioning and to monitor the implementation of recommendations of the DSRP.

7. In analyzing the needs of the CWC-DSO to exercise the preceding functions, it is concluded that 57 (32 technical, 25 support) persons are required (Table 1). This is considered sufficient for managing and providing overview at the national level. An over-staffed national unit would only serve to impede progress at the state level. The cost over the 5-year term is estimated to be Rs.16.2 million including office expenses and travel.

8. A Hydrology Unit exists within the Water Planning Directorate of CWC. At the present time however, this unit is fully occupied discharging its normal responsibilities. The added scope of work created by the project consists of developing and providing hydrologic guidance to the states for both rough screening and detailed analysis of existing dams, of vetting the hydrologic evaluations done by the states where the remedial work involves major modifications in spillway capacity, of reviewing the total hydrology for identified important dams, and of performing necessary liaison and overview with the Indian Meteorological Department (IMD) in developing regionalized Probable Maximum Precipitation (PMP) and Standard Project Storm (SPS) for the nation.

9. The major effort of the Hydrology Unit will take place in the first few years of the project when special guidance for hydrologic screening and determining spillway adequacy would be developed along with the PMP, and SPS regional charts. During this period, the state technical personnel would be gaining experience to enable them to have less reliance on CWC Hydrology Unit in the future.

10. In analyzing the additional needs of the Hydrology Unit to exercise the preceding functions, it is concluded that 46 (23 technical, 23 support) persons are required. The cost over the 5-year term is estimated to be Rs.12.7 million, including office expenses.

Institutional Strengthening of State Dam Safety Organisations (SDSO)

11. The safety of dams in India is the responsibility of the state agencies, who will continue to conduct the various aspects of investigation, planning, design, construction and operation and maintenance. Maintenance and upkeep of dams has been recognised as an important activity and almost all the agencies responsible for this activity have established norms and procedures for surveillance of dams through a procedure for annual inspection and reporting.

12. Four participating states of Madhya Pradesh, Rajasthan, Tamil Nadu and Orissa have widely varying existing staff for their SDSOs. The number of large dams in the four states also vary considerably from 86 in Tamil Nadu to 608 in Madhya Pradesh). Both these factors have been taken into account while making provision of incremental staff.

13. Incremental staff considered justified for the functions to be performed directly by the strengthened SDSO and by other related units of each of the four states are indicated in Table II. The total incremental staff provided for the four states is 312 (167 Technical and 145 Support) persons. Out of this 179 (98 Tech: and 81 Supp:) are for the SDSO and 133 (69 Technical and 64 Support) are for hydrology, structural design and other units.

14. At the state level the project will provide a variety of equipment required to support the expanded organisations and activities. There will be office equipment including typewriters, copiers, files, computers, telephones, and other item. The addition of vehicles to transport inspection teams to the widely dispersed sites is vital to meet the inspection frequencies required.

15. Most of the existing SDSO have very little technical reference material. There is a large amount of published material available internationally on the subjects of dam engineering, hydrology, geotechnical engineering and dam safety procedures and approaches. A very important element of the project will be for CWC-DSO to assemble a standard technical library to be supplied to each State Dam Safety Organisation.

16. The following Table 1 and Table 2 summarizes the incremental additional staff to be provide under the project at CWC and the State respectively.

INDIA

DAM SAFETY PROJECT

Incremental Manpower - CWC

	<u>Technical</u>	<u>Support</u>	<u>Total</u>
Chief Engineer's Office	1	3	4
Monitoring Directorate	13	11	24
Special Analysis Directorate	11	8	19
Rehabilitation Directorate	<u>7</u>	<u>3</u>	<u>10</u>
Total	32	25	57
<u>Hydrology Organization</u>			
Chief Engineer's Office	1	3	4
Review Directorate	<u>22</u>	<u>20</u>	<u>42</u>
Total	23	23	46
Grand Total	<u>55</u>	<u>48</u>	<u>103</u>

**INDIA**

**DAM SAFETY PROJECT**

**INCREMENTAL MANPOWER - STATES**

<u>State</u>	<u>Technical</u>	<u>Support</u>	<u>Total</u>
<b><u>Madhya Pradesh</u></b>			
Dam Safety	24	21	45
Hydrology			
Structural & Others	26	30	56
Total	50	51	101
<b><u>Rajaasthan</u></b>			
D.S.O	27	25	52
Hydrology			
Structural & Others	14	14	28
Total	41	39	80
<b><u>Tamil Nadu</u></b>			
D.S.O.	22	12	34
Hydrology			
Structural & Others	12	9	21
Total	34	21	55
<b><u>Orissa</u></b>			
D.S.O.	25	23	48
Hydrology			
Structural & Others	17	11	28
Total	42	34	76
<b><u>Total in 4 States</u></b>			
SDSO	98	81	179
Hydrology			
Structural & Others	69	64	133
Total	167	145	312

Annex 2  
Table 3

INDIA

DAM SAFETY PROJECT

COST OF INCREMENTAL STAFF & CONTINGENCIES  
COST (Rs. Millions) - C.W.C.

	<u>Recurring</u>	<u>Non-Recurring</u>	<u>Total</u>
Dam Safety Organization	16.15	4.36	20.51
Hydrology Organization	12.65	15.80	28.45
Total	28.80	20.16	48.96

Annex 2  
Table 4

INDIA

DAM SAFETY PROJECT

COST OF INCREMENTAL STAFF & CONTINGENCIES  
COST (RS. MILLIONS) - STATES 1/

<u>STATE</u>	<u>Recurring Staff</u> <u>for 5 years</u>	<u>Non-Recurring</u>	<u>Total</u>
Madhya Pradesh	30.635	7.131	37.766
Rajasthan	24.250	7.100	31.350
Tamil Nadu	19.860	5.900	25.76
Orissa	21.000	6.764	27.764
Total of 4 States	95.745	26.895	122.640

---

1/ Recurrent operating costs not shown.

INDIA

DAM SAFETY PROJECT

TOTAL INCREMENTAL MANPOWER PROVIDED IN DSAR PROJECT

	<u>Technical</u>	<u>Support</u>	<u>Total</u>
C.W.C.	55	48	103
<b>States</b>			
Madhya Pradesh	50	51	101
Rajasthan	41	39	80
Tamil Nadu	34		
Orissa	42	34	76
<b>Total States</b>	<u>167</u>	<u>145</u>	<u>312</u>
<b>Grand Total</b>	<u>222</u>	<u>193</u>	<u>415</u>

**INDIA**

**DAM SAFETY PROJECT**

**TOTAL COST OF INCREMENTAL STAFF & CONTINGENCIES**  
**IN DSAR PROJECT - (RS. MILLION)**

<b>C.W.C.</b>	<b>5 Years Recurring</b>	<b>Non-Recurring</b>	<b>Total (Rs.M)</b>
D.S.O.	16.15	43.6	20.51
Hydrology	12.65	15.80	28.45
<b>Total C.W.C.</b>	<b><u>28.80</u></b>	<b><u>20.16</u></b>	<b><u>48.90</u></b>
<b>States</b>			
Medhya Pradesh	30.6	7.1	37.7
Rajasthan	24.3	7.1	31.4
Tamil Nadu	19.9	5.9	25.8
Orissa	<u>21.0</u>	<u>6.8</u>	<u>27.8</u>
<b>Total States</b>	<b><u>95.8</u></b>	<b><u>26.9</u></b>	<b><u>115.7</u></b>
<b>Grand Total</b>	<b><u>124.60</u></b>	<b><u>47.06</u></b>	<b><u>171.66</u></b>

INDIA

DAM SAFETY PROJECT

BASIC DAM SAFETY FACILITIES

1. Many of the older dams were not originally equipped with adequate instrumentation, communication systems and other facilities that have a bearing on monitoring the dams performance or assisting in their safe operations. This project will include upgrading a variety of basic facilities at approximately 10% of the existing large dams in each participating state except in Madhya Pradesh where due to the large number of dams only about 5% will be addressed.

2. It is planned that work in this category can be initiated early in the project period since the level of investigation, design and procurement is much less complex than for remedial work on distressed dams. The primary objective of the basic facilities component is to add features in and around the dam complex that will assist in proper surveillance and operations during the monsoon season.

3. A typical configuration of large dams in India is to have a center section of concrete or masonry forming an overflow spillway with crest gates. This center section is flanked by long earth fill sections outside the riverbed extending to the edge of the wide valleys. The overflow gates are regulated during the latter phases of the monsoon season to capture enough of the flow to end the season with a full reservoir. There is always the risk of a late flood when the reservoir is nearly full and operations at higher stage requires very timely and well coordinated gate manipulation to safely accommodate the flood flow. The combination of all-weather access to the dam, communications to the operators and standby power sources for gate operations are facilities that can enhance the safety of the dam during flood operation. Measurements of precipitation and reservoir levels, plus communication links to civil authorities also contribute to the basic safety of dams and are included for selected dams under the project.

4. The following is a generalized listing of the type of facilities to be considered for selected dams under the project. The features included at each dam will vary according to the needs and no one dam will have all of these features added to it.

a) Site Access

- Widening, realigning or surfacing existing access roads to allow vehicle access under adverse weather conditions
- Adding connecting roads to each abutment if none exist

b) Spillway Gate Operation

- Providing on-site diesel generator set for standby power
- Providing spare hoist motors
- Providing duplicate hand operating cranks or wheels
- Providing lighting to operating areas
- Providing gate opening indicators

c) Measuring Devices

- V-notch weirs and collector system for measuring seepage flow
- Recorders to provide continuous record of seepage flows
- Piezometers in earth sections to measure internal hydrostatic pressures
- Rain gauges
- Control points to monitor settlement or displacement
- Reservoir level gauge and recorder
- Gauge for measuring river inflow
- Wind velocity and direction instruments
- Wave height measurement
- Climate instrumentation - temperature, humidity, atmospheric pressure, evaporation
- Siesmic instruments (if warranted)
- Water quality sampling equipment (variable reservoir depths)

d) Communication Facilities

- Radio or duplicate telephone systems to officials associated with operations
- Communication connections to upstream villages as observation posts for flood warning
- Local warning equipment such as siren or horn
- Flood lights or spot lights for use in communications or warning

e) Strategic Materials Stockpiles

- Stone for wave wash protection and blow hole repair
- Unfilled sand bags in dry storage
- Sand bag material
- Timber and steel structural members
- Rope and floating life saver rings
- Heavy plastic sheeting
- Steel cabling and attachments

5. The base costs (without contingencies) for the basic facilities for each of the States have been estimated as shown in the following tabulation. This is a pre-set allocation among the States and once an individual state has expended their share, no additional funding will be provided unless it is a reallocation agreed to by all states.

<u>State</u>	<u>Amount in Rs. million</u>
Madhya Pradesh	175.0
Orissa	92.4
Rajasthan	77.1
Tamil Nadu	<u>57.2</u>
<b>Total</b>	<b>401.7</b>

INDIA

DAM SAFETY PROJECT

EVALUATION OF THE FLOOD HANDLING CAPABILITY  
OF EXISTING DAMS AND SPILLWAYS

1. Studies published by the International Commission on Large Dams (ICOLD) on the causes of failures of dams indicate that approximately one-third of the failures are a direct result of floods exceeding the capacity of the spillways. The examination of the flood handling capability for existing dams and spillways is therefore a vital component of any comprehensive Dam Safety Assurance Program. As more records are maintained and data compiled on the magnitude and characteristics of floods, there becomes a broader knowledge base upon which to base the estimation of possible future flood events. Scientific advances in meteorology and hydrologic analysis over the last two decades have given scientists and engineers many new tools and advanced methodologies to allow more realistic calculation of the upper limits of rare flood events. Thirty to forty years ago, certain levels of risks were taken unknowingly by engineers and public funding agencies in sizing spillways. In many cases the spillways were designed only to safely pass floods that might be expected to occur once in 100 to 500 years. The level of ever increasing development in the river valleys below existing dams and new dam sites create a potential hazard to property damage and loss of life that is much greater than in the past. The existing dams in India, which in many cases were designed to outdated standards and with empirical formula for roughly estimating flood magnitudes, must now be re-examined and re-evaluated in regard to spillway capacity.

2. In India, the present standards for new large dams require the dam, reservoir and spillway complex be capable of safely accommodating the inflow of the Probable Maximum Flood (PMF) or if less than a certain height and capacity, the Standard Project Flood (SPF). The PMF is a flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The most critical meteorologic event used to compute a PMF is the Probable Maximum Precipitation (PMP). Procedures and standards requiring dams and spillways for large dams to be designed to handle the PMF have been in existence in India for approximately the last decade. Existing dams built prior to that time were based on a variety of standards and methods of calculation of the design flood which in general were smaller than the PMF.

3. An important sub-objective of the Dam Safety Project is to strengthen the technical capability of the states to reassess all their existing dams in regard to flood handling capability. The CWC's technical guidance, training and direction of national policy on hydrologic capability of existing dams is a critical element in attaining this goal. The following summarizes the approach, activities, time frames and inter-relationships of CWC and the states in carrying out the re-evaluation of hydrologic adequacies of existing dams.

4. The first activity of CWC under the project will be to develop guidelines and procedures for making a quick screening of dams within the participating states for the relative magnitudes of the PMF or SPF in comparison with the design flood employed at the time the dam was initially designed and constructed. By preparation of an envelope curve of recently computed PMFs in the region plotted against basin drainage area, a rough indication of the magnitude of the PMF for the subject existing dam will be obtained. Those dams where this approximate PMF deviates significantly from the value of flood used in the designs will then become a prominent candidate to be placed high on the priority for Phase I inspections as provided for in the states Dam Safety Assurance Programs. The preparation of these envelope curves has been initiated and is due to be completed by CWC in the first quarter of 1991. Guidelines for the application of this approach and training to state DSO personnel will be carried out by the Hydrology Organization of CWC.

5. A second stage or intermediate level hydrologic review would be made during the Phase I inspections, especially for those dams showing potential inadequacies on the basis of the previously defined screening process. CWC Hydrology Organization will prepare and issue a manual outlining a more detailed procedure for utilizing a unit hydrograph for the catchment area and an approximation of the PMP and the Standard Project Storm (SPS) or other appropriate rainfall values. The manual will cover the computational methodology, commonly used computer programs, and guidelines on making assumptions for infiltration rates, base flow, times of concentration and other relevant factors.

6. While the screening and second stage review provide rough checks on the flood characterization, in each case the result of the flood inflow on the dam, reservoir and spillways must be simulated by making flood routing computations. CWC-DSO will provide written guidelines and standards on assumptions to be made for potential gate malfunction, pre-flood reservoir levels, freeboard, and other relationships for the process of computing the inflow, outflow and storage as the flood is mathematically modeled for being "routed" through the system.

7. Should these two reviews show deficiencies, then a detailed and full level re-evaluation of the flood handling capability of the subject dam(s) and spillway will be performed. The critical element of the detailed review is the determination of the PMP, SPS or otherwise appropriate rainfall amounts to be used in estimating the flood.

8. The present general procedure used in making computations of the PMF for new dams or checking those for critical older structures, is to make a formal request to the India Meteorological Department (IMD) on a project-by-project basis asking for the rainfall values of the design storm or the PMP and its characteristic spatially and over time. For the purpose of re-evaluation of hundreds of dams annually for dam safety analysis, the case by case furnishing of the rainfall data by IMD is impractical. It was decided to have the Dam Safety Project include having IMD prepare regional "charts" or "atlases" that provide the PMP values for use in flood hydrology computations. The atlases will be prepared first for the geographical area of the four participating states and then expanded to cover the entire country of India. The first component will be completed within three years with the total national atlases prepared within four and a half years.

9. CWC will coordinate the progress and activities of IMD in this effort and a special review committee will be formed by CWC and IMD to monitor and provide general review of the IMD activities and the final product. A similar process with IMD and CWC will produce atlases for the Standard Project Storm values over the region including the four participating states.

10. Of the 33 dams identified to require the initial remedial action, only five have been re-evaluated for flood handling adequacy under current Indian standards. A program and schedule has been set out for the hydrology analysis to be conducted by CWC Hydrology Organization on a case by case basis. The hydrologic adequacy of the dam and spillway is a prerequisite for completing the plans for remedial action unless there are emergency or extremely urgent actions needed structurally that are independent of the spillway. To aid in the training of state hydrology specialists and to assist the CWC Hydrology Organization will arrange for state personnel to be temporarily assigned to CWC headquarters. Table 1 at the end of this annex outlines the schedule of the CWC Hydrology Organization in carrying out of flood hydrology analysis.

11. In the later stages of the project after the IMD atlases are complete, it is planned that training sessions for state hydrology personnel would be carried out. The state staff who have by then gained experience from working alongside CWC staff, would prepare their own flood hydrology analysis at the state level. Prior to using the flood hydrographs in analysis for dam and spillway modification, any states hydrology flood computations would be vetted by the CWC-Hydrology Organization.

INDIA

DAM SAFETY PROJECT

CWC - HYDROLOGY ORGANIZATION SCHEDULE  
FOR HYDROLOGICAL REVIEW OF DAMS  
UNDER PROGRAM FOR REHABILITATION

<u>Item</u>	<u>Target Date</u> <u>for completion</u>
1. Hydrologic review of following dams	April 1, 1991
a) Pagara	
b) Pitlowa	
c) Kotwal	
d) Gandhi Sagar	
e) Periyar	
f) Kodaganar	
2. Hydrologic review of Three category C dams in Orissa	April 1, 1991
3. Completion of hydrologic review of Tigra Dam	August 1991
4. Hydrological review of Hiramund Dam	4 months after augmented staff in position
5. Hydrologic review of Rana Pratap Sagar, Jawahar Sagar and Kota Barrage can be addressed only after decision on Gandhinagar has been taken.	4 months after augmented staff in position and Gandhinagar spillway decision made.
6. Hydrologic reviews of all other dams Other category B Dams	4 months after staff is in position
Other Category C Dams	After 1993
To be performed by the States	To be vetted by CWC

INDIA

DAM SAFETY PROJECT

REMEDIAL WORKS

Establishing Priorities for Inspection and Selection for Remedial Action

1. It is important for the project to assure that the limited resources suitable are utilized in the most effective and efficient manner possible. This requires that attention be directed to those potential problem dams posing the highest degree of risk. To accomplish this requires the establishment of some sort of screening methodology - albeit not precise - which can be used to establish a group rank order of some type for pursuing the Phase I inspection, the Phase II evaluations, where necessary, and to select dams requiring remedial work on a logical priority basis.
2. While the most ideal way to establish priorities for initial investigation would be on a nationwide scale, this would become an imponderous and unworkable approach. The states are the only institutions possessing the intimacy needed to evaluate the situation. However, it is also necessary that a degree of uniformity be applied throughout the country. It is, therefore, necessary for CWC to provide to the States, the requisite guidance to aid in prioritizing the work involved with dam safety.
3. As a first order, each state should conduct a hazard classification of all large dams. CWC-DSO should assist with guidelines on how to sub-divide the high hazard potential classification category contained in Table II of the "Guidelines for Safety Inspection of Dams". This is necessary as the bulk of the large dams are high-hazard dams and further delineation into sub-groups is required before prioritizing for Phase I inspections. It is suggested that the high hazard category be divided into 3 to 4 sub-groups but still based on gradations of potential loss of life and economic loss. Hazard classification should always remain the primary factor for distinguishing an order of priority. Within each of the sub-groups developed, the dams can be further classified and sub-divided by grouping into 3 to 4 sub-categories based on a combination of storage capacity and height of dam.
4. Historically in India and internationally, it has been found that hydrologic deficiencies are one of the most common threat to dam safety. Several factors contribute to this situation: (a) the potential for infrequent events producing extraordinary precipitation had not been considered during design; (b) the determination of such events was hampered by inadequate basic data; (c) and the realization that precipitation forecast for rare events have been approached. To provide a tool for the states to use in further delineation of priorities for Phase I inspections, the CWC will develop parametric envelope curves (order of magnitude curves) for PMF/SPF based on the best available comparative data. These guidelines curves will be

used by the states in making a broad screening for the purpose of identifying potential hydrologic problems and helping to set priorities for which dams to address first.

5. Not related to priority setting for the Phase I inspection, but vital to determining spillway adequacy during the Phase I inspection, is the need for a parametric method of routing the flood and analyzing other aspects which could be used to determine whether a Phase II investigation is required. The approach will be designed to give results which will produce the degree of deviation from the required spillway standard which then can be used to evaluate the priority of Phase II investigations. A guideline manual for this type of quick review should be produced by the CWC-DSO.

6. Since pre-and post-monsoon inspection reports prepared by the O&M units are available for all dams, and in some cases have identified deficiencies or suspected deficiencies, these can be further used to help set the priorities for the Phase I inspection.

7. Taking into account the hazard classification, the potential hydrologic deficiencies and the known physical deficiencies, the State Dam Safety Organization should in the early stages of the project, develop a group order ranking that reflect the risk and thereby establishes the schedule of priorities for conducting the Phase I inspection. This by necessity requires the application of composite judgement in the processes.

8. Priority for Phase II investigations is necessarily dependent on the findings of the Phase I inspections. Using the relative degree of deficiency exposed by the Phase I inspection, the SDSA should recommend an order of priority for conducting the Phase II investigation to the State Dam Safety Committee.

9. As a result of the Phase II investigation, the problem will be defined to the extent that a remedial solution can be postulated. At this time, it will be necessary to balance the cost of the solution, the severity of the deficiency and the risk involved. This should be done by the SDSA with recommendations to the State Dam Safety Committee who will establish the priorities for designing and undertaking the remaining activities of investigations, designs and contracting to carry out the remedial work.

#### Implementation of Remedial Work

10. The primary target of this project is to develop the institutional means and capacity to ensure the establishment and perpetuation of a viable dam safety assurance program in each state. However, there is also support for remedial work on 33 sub-projects which have deficiencies already identified through partial implementation of the program. Inclusion of remedial work in the project will serve as an incentive for the respective states to strengthen their institutions, accelerate inspections, undertake investigations and improve the operational facilities for reacting to threatening floods. Carrying out remedial works will also provide a better perspective to the states of what constitutes a total dam safety assurance program and enable the

organization to evaluate the efficacy of the program. It will also enable the staff institutions to evaluate and adjust the procedures for selecting and utilizing the mandatory Dam Safety Review Panels (DSRP).

11. The 33 dams initially identified for remedial action have been categorized by a combination of readiness of investigations, analysis and design as well as critical need for rehabilitation work. The categorization is defined as follows:

Category A Dams (7 Dams)	-	Top priority dams with evaluations and designs nearly complete (Hydrologic reassessments already made)
Category B Dams (5 Dams)	-	Deficiencies identified but investigation and evaluation incomplete. (Hydrologic reassessment not yet made)
Category C Dams ( 21 Dams)	-	Partial deficiencies identified, no significant investigations or designs made. (Hydrologic reassessment not yet made)
Category D Dams (undetermined)	-	Dams yet to be fully inspected and evaluated. Hydrologic reassessment most likely required.

Table 1 at the end of this section lists the names of the 33 dams presently identified for remedial works. By year two or three of the project, some of the dams being inspected and evaluated under the expanded activity of the SDSO, may be determined to be more critical in nature than those presently included in the type C category. The states will maintain an active listing of the categorization of the dams planned to be rehabilitated under the project. This will be reviewed with CWC at each of the bi-annual project management meetings.

12. Table 2 lists the total estimated base costs of the 33 dams by state and by category. These costs are very preliminary because the full extent of the work required has not been determined in detail. Some of the estimates may be conservative in that work estimated at the present time may not ultimately be required. There is also the situation of construction periods needing to be extended over a number of years in cases where normal operation prohibits the remedial activities.

13. The schedule at the end of this annex, illustrates the relative typical time estimated to be required to complete the process of remedial action for a typical dam in category D, B, C, and A. The category D dam would take the longest period due to the time required for initial inspection, evaluations, prioritizations, and eventual design and construction. With over 900 dams in the four states in the category D, only a few will be able to be processed

within the time-frame of the project. All the dams go through the same general sequence as shown in the implementation schedule. At the start of the project, however, some dams have already been through the basic initial activities, al beit in a less formal manner, but now require a fewer number of actions before being ready for remedial action.

14. In all cases, the proposed remedial work will be reviewed by the newly appointed DSRPs of each state. In some cases, there will be a need for multiple reviews as renewed investigations, modified analysis approaches or revised designs may be required.

15. Following the approval of the sub-project remedial action plans, the state design units of the irrigation department or other owner agencies will indicate the construction packaging and cost estimates for the remedial works. There may be multiple contracts due to the requirements for specialized services. There may also be a combination of force account work by state construction forces and contracted work. These remedial action plans will be brought to the CWC-DSO unit for procedural clearance prior to tendering contracts for construction. This CWC clearance will be a "proforma" type clearance similar to that used by CWC on "medium irrigation projects". The exception to this is in regard to sub-projects where the state engineers have prepared the hydrology evaluations, which must be vetted by the CWC Hydrology Unit. Very few of those cases should occur during the project since the CWC-hydrology unit is scheduled to perform the hydrologic analysis on the remaining of 28 or so dams of the 33 dams in the initial group.

16. The remedial works cost comprise almost 70 percent of the total project-base cost. As there will adjustments in cost estimates of the facilities as the project progresses, there is no pre-project allocation of funds to any individual dam. Each case will be evaluated for implementation as the designs are completed and cleared.

17. Of the 33 dams in the project, Hirakud Dam warrants special mention. The amount included in the estimate (Rs.317.5 million) is based upon the estimated cost to complete sealing the upstream face of the right bank concrete spillway section work which has been started. Historically, the problem of deterioration of the concrete in this dam has been under study for some time; however, a cause for the concrete degradation (in various forms) has not been established. Without understanding the cause, it may not be prudent to undertake a program to repair the visible deficiencies (cracks). This proposed sealing work has not had the benefit of review by a Dam Safety Review Panel.

- (a) At the time of project appraisal a special panel to evaluate the "cracking" at Hirakud Dam had been formed and held two or three meetings to determine the causes, extent and progression of the concrete cracking. The Government of Orissa in September 1990 requested an international team of experts be formed to assist in assessing the basic cause of the concrete problem and to help devise a comprehensive remedial action plan. GOI is awaiting the results and recommendations of the existing panel evaluating the cracks before taking any further action.

- (b) Considering the suspected distressed condition of the dam, expedited efforts are needed to review the studies made to date, to determine further exploration and investigation needed to assure definition of the problem, to determine propriety of the proposed repair at the upstream face and to prescribe a course of action to resolve the problem. Implementation studies and the overall solution should be under the overview of a Dam Safety Review Panel.
- (c) The development of a comprehensive remedial action plan should be taken before any disbursements are made for Hirakud remedial work under this project. As the cost estimates become available for the total remedial action, there may be a need to consider new and separate project, solely for the rehabilitation of Hirakund Dam.
- (d) In addition to the observed structural distress, hydrologic reassessment of the design flood has been made for the basin above Hirakud Dam within the last decade. The spillway capacity had been determined to be undersized and some studies were performed on alternative means to upgrade the capability. Since new methods of performing the hydrologic analysis in estimating the design flood, are now in force, an updated estimate of the Probable Maximum Flood will be performed under this project. No cost estimates, however, have been included in this project for spillway modifications.

INDIA

DAM SAFETY PROJECT

SEQUENCE OF ACTIVITIES FOR TYPICAL DAM REHABILITATION

Activities	Elapsed time in years																							
	1				2				3				4				5				6			
TYPICAL CATEGORY DDAM (Inspections yet to be made and deficiencies not identified)	(Average implementation period 5.5 years)																							
TYPICAL CATEGORY CDAM (Partial deficiencies identified without significant investigation completed)	(Average implementation period 5.0 years)																							
TYPICAL CATEGORY BDAM (Deficiencies identified but investigations and evaluations incomplete)	(Average implementation period 4.5 years)																							
TYPICAL CATEGORY ADAM (Top priority with design & evaluations, including hydrologic, nearly complete)	(Average implementation period 3.75 years)																							
Perform "Hazard Classification" for all dams in state	■																							
Review records and pre/post monsoon inspection reports	■																							
Examine Risk and Hazard Potential & Prioritize dams for inspection	■																							
Collect data for hydrologic review	■																							
Conduct Phase I inspections	■																							
Conduct hydrologic review in consultation with CWC	■																							
Establish evaluation team for Phase II analysis	■																							
Conduct Phase II evaluations	■																							
Conduct detailed hydrologic analysis and flood routing if needed	■																							
Select, sanction and activate DSRP	■																							
Evaluate distress problems and prioritize with D.S. Committee	■																							
Conduct final field investigations	■																							
Carry out technical analysis and prepare preliminary design	■																							
Conduct flood routing and propose spillway modifications if any	■																							
Present technical approach, analysis and designs to DSRP	■																							
Respond to points and suggestions of DSRP	■																							
Obtain final approval of DSRP	■																							
Obtain CWC concurrence and procedural clearance	■																							
Prepare contract documents	■																							
Call for and evaluate bids, select contractor and sign contract	■																							
Construction period for remedial works-Supervise work	■																							
Prepare completion report	■																							
Submit reports, records and data to SDSO	■																							

Construction period will vary considerably from case to case-2.5 years shown here as typical

**INDIA**

**DAM SAFETY PROJECT**

**Table 1 - List of Dams Previously Identified  
to Receive Remedial Works**

<b>State</b>	<b>Category</b>	<b>Dam</b>
Madhya Pradesh	A	Pagara Pillowa Kotwal Gandhisagar
	B	Tigra
	C	Kaketo Barna Aoda
Orissa	A	Hirakud
	B	None
	C	Darjang Ghodahada Soroda Bhanjanagar Behera Ganianala Jharnai Alikuan
Rajasthan	A	None
	B	Ranapratap Sagar Jawahar Sagar Kota Barrage
	C	Parbati Matri Kundia Alnia Galwa
Tamil Nadu	A	Periyar Kodaganar
	B	Sathanur
	C	Pechiparai Manimuthar Uppar Ponnaniar Gomukhinadhi Vidur

INDIA

DAM SAFETY PROJECT

Table 2 - Estimated Remedial Works Costs  
by Category of Readiness

	<u>Estimated</u> <u>Construction Cost</u> <u>(in million Rupees)</u>
Category A Dams	775
Category B Dams	378
Category C Dams	794
Category D Dams	<u>Unidentified</u>
<b>Total</b>	<b>1,947</b>

INDIA

DAM SAFETY PROJECT

DAM SAFETY REVIEW PANELS

1. The World Bank operating procedures require the formation of a Dam Safety Review Panel (DSRP) for large dams associated with Bank-funded projects. Under this Dam Safety Assurance and Rehabilitation Project, the utilization of DSRPs by each participating state is a vital component of the project. Initially, one DSRP will be formed for each state, yet the workload, complexity of proposed remedial actions and other scheduling factors may require more than one panel in a state.
2. The objective of the DSRP is to provide an independent overview of the reports of distress observed, the investigative analysis performed, and the remedial actions proposed prior to initiation of rehabilitative activities for the dams. The broad experience of the members of DSRP in dam engineering will be applied to assure that appropriate diagnosis of the distress conditions has been made and that the remedial actions proposed by the state are suitable to restore the dam to an acceptable safety status. Care must be exercised by the DSRP to not demand incorporation of minor cosmetic elements, regular maintenance actions or items not relevant to the safety of the dam, yet the examination and evaluation of key elements having a bearing on the dam's safety status must be thorough and backed by sound technical judgement.
3. The DSRP will be evaluating a number of dams at the same time, each of which will be in a different stage of the investigative, design or implementation stage. The DSRP will be also presented information and results of the remedial action construction and will be required to respond to any special technical problems or questions that may arise during that time.
4. CWC and the Bank may attend and observe any of the DSRP meetings. The states will be informed by CWC and the Bank of their intention to attend any particular DSRP meeting. Following the meetings, written comments by CWC or the Bank may be presented where deemed necessary. The states will be obligated to make written responses indicating the actions they have taken on matter so called to their attention.
5. Attachment 1 to this annex summarizes the selection criteria outlined by the World Bank to the participating states. At the time of appraisal the following selections had been made by the respective states and approved by the Bank.

<u>State</u>	<u>DSRP member and specialty</u>	
Madhya Pradesh	Dr. K. C. Thomas	Chairman
	Mr. K. Madhavan	Dam Designs
	Mr. A. S. Chatrata	Dam Construction
	Mr. T. Kumaran Das	Hydrology
	Mr. K.C.C. Raju	Engineering Geology
Orissa	Mr. M.G. Padhye	Chairman
	Mr. R. S. Varshney	
	or Mr. K.N. Raju	Dam Designs
	Mr. S. Balasubramanyan	
	or Mr. M. P. Tyagi	Dam Construction
	Dr. Satish Chandra	Hydrology
	Mr. G.S.M. Rao	Engineering Geology
Rajasthan	Mr. Pritam Singh	Chairman
	Mr. S. N. Guru Rao	Dam Designs
	Mr. K.P. Datye	Dam Construction
	Mr. S. M. Seth	Hydrology
	Mr. K. N. Srivastav	Engineering Geology
Tamil Nadu	Mr. G. N. Tandon	Chairman
	Mr. V. A. Parkash	Dam Designs
	Mr. R. Ramaswamy	Dam Construction
	Mr. D. P. Ghosh	Hydrology
	Mr. Chalapathy Rao	Engineering Geology

6. Attachment 2 to this annex is the Terms of Reference (TOR) covering the activities and actions to be performed by the DSRP, the state, CWC and the Bank for review of existing dams. This TOR has been approved by the Indian National Dam Safety Committee and by the World Bank's India Dam Safety Committee, and will be used to guide the DSRP activities under this project.

7. The DSRP for each state will meet regularly as required to make the necessary reviews of the proposed action-plans for the remedial work under the project. Most commonly more than one individual dam will be addressed at each meetings.

8. The full membership as described in the attached TOR will be maintained during the duration of the project. Members who are unable to continue serving on the DSRPs will be promptly replaced with the replacement member nomination made in coordination with CWC-DSO and then submitted to the Bank for acceptance.

Procedures and Criteria for  
Selection and Use of  
Independent Dam Safety Review Panels

This note sets out the procedures and criteria to be followed in the establishment and operation of an independent Dam Safety Review Panels (DSRP), for World Bank assisted projects. The attached Terms of Reference (TOR) as applicable will be followed. For dams not covered under any of the attached TORs, modifications may be agreed.

1. Timing

When a project with a dam is contemplated to be funded through the World Bank, the DSRP membership should be proposed by the State Governments during the early preparation missions to allow the DSRP to review dam site investigations, designs and implementation programs prior to final World Bank appraisal for funding. World Bank concurrence should be requested in writing from the World Bank staff conducting the project preparation missions. Such requests will be accompanied with the biographical data of the proposed membership. The World Bank concurrence or objection to the proposed DSRP membership and chairman will be made to the States through CWC. The DSRP will continue to function until after construction of the related works and into the operations phase.

2. Qualifications and Criteria for Membership of DSRP

Proposed DSRP members should have:

- o Extensive experience in the actual conduct of specific technical work and be recognized as an expert in the particular specialty called for in the TORs.
- o A positive past work experience record and performance results with excellent standing among peers in the specific field.
- o Worked a substantial proportion of their career (typically in the order of twenty years) in engineering on dam projects, with at least five years in responsible charge while engaged in problems of the scale and type anticipated to be reviewed.
- o Not previously worked directly on any project to be reviewed.

3. DSRP Chairman

Special attention should be given in the States selecting and designating the DSRP chairman. In addition to the other membership qualifications, the proposed chairman shall have a broad technical understanding of dam engineering and associated specialties. It is desirable that he has experience in serving on a similar panel for a dam of comparable magnitude, complexity and characteristics.

4. Large or Complex Projects

For very large dams or those with known technical complexities, selection of one or more foreign experts may be required to facilitate the introduction of new technologies and to broaden the DSRP contact with international experts.

5. Short-term Experts

After the DSRP is formed and active, they may select and request the services of short-term experts in accordance with the provisions of the applicable TORs.

6. Sources of Information on Potential DSRP Members and Short-term Experts

The States should seek information from all possible sources in identifying and selecting DSRP member candidates. A list of suitable candidates for DSRP membership and short-term experts in various disciplines will be maintained by CWC for assistance to the States. This list will be regularly reviewed and updated. The World Bank will, upon request, assist in identifying expatriate DSRP candidates or short-term experts in various specialties among experts.

7. Role of Participating Entities during the Active Period of the DSRP

State: The state will provide advance project information and data to the DSRP, make arrangements for visits to the site and meetings with the project staff and consultants, if any, and provide other support elements identified in the applicable TORs. The state will subsequently report actions taken in response to DSRP recommendations.

CWC: The CWC will participate in DSRP meeting as described in the TOR. It will provide review, monitoring and reporting functions in accordance with the pertinent CWC rules and instruction.

World Bank: The World Bank will approve the membership of the DSRPs. Representatives of the World Bank may attend the DSRP meetings as observers. The World Bank will not otherwise participate in the DSRP review activities

World Bank Aided Projects with Existing Dams  
exceeding 15m in height or storage volume of 60Mm<sup>3</sup>

Terms of Reference for  
Dam Safety Review Panels

(The State)

(The Project)

Responsibility for all matters relating to dam safety during design, construction, and operation rests with the owner, normally the State. A Dam Safety Review Panel (DSRP) provides independent expert review and comment on safety matters to the owner, and to the Bank. The functioning of such a panel, which is advisory, in no way detracts from or substitutes for the expertise, resources, or responsibilities of the owner. The panel's purview is strictly limited to safety matters, and does not extend to financial or economic issues, selection of alternative designs, construction phasing, or any other features of the facilities except where safety is involved.

General and Purpose

1. In situations where a dam has been designed, constructed, or brought into operation without participation of a DSRP, or in situations where Bank-supported investments depend upon upstream facilities which have not been subjected to safety review, independent inspections are required. Accordingly, a DSRP shall be established for (the project) by (the state government) to undertake periodic, comprehensive, independent reviews with the objective of evaluating features and actions pertaining to the safety of the dam, and providing recommendations to (the state government) of actions that may be needed to upgrade the dam and appurtenances to acceptable safety standards. The DSRP shall be guided by the dam safety assurance objectives of the Government of India, (the state government), and related legislation, regulations, standards and guidelines.

Organization and Membership

2. The DSRP shall contain a nucleus of members having expertise in the following disciplines: (a) flood hydrology; (b) engineering geology (dam foundations); (c) dam design (concrete, rockfill, earthfill as appropriate); (d) dam construction, engineering and management. There should be four to six members of the DSRP, but all four disciplines should be fully represented. Should the project involve hydropower generation as an integral part of the dam and outlet works, an expert on the design and construction of power plants and appurtenant waterways shall also be included as a member of the DSRP.

3. A Chairman shall be appointed amongst the members by (the state

government) to coordinate the communications of the DSRP, to call and chair its meetings, to ensure the membership's objectivity, and to provide balance to its reviews and recommendations. The person responsible for correspondence with the Chairman shall be nominated by (the state government).

4. The flood hydrology member may be released at the discretion of the DSRP.

5. When, in the judgement of the DSRP, additional specific expertise is required, the Chairman will nominate qualified expert(s) for appointment to the panel to perform special assignments or evaluations on short notice, and report results directly to the panel. The assignments of such experts shall not exceed an aggregate time of ( ) mandays per year; additional time may be allowed subject to direct approval by (the state government) upon written request and justification by the DSRP.

#### Meetings

6. The DSRP will meet as frequently as judged necessary by the Chairman to assess the status of (the project) and to present recommendations.

7. DSRP meetings will normally be held at the project site, and attended by all members. Individual inspections of the site, designs, or construction work should occur only under special circumstances, and in such cases the member will send his report of findings to the other panel members for issuance jointly after concurrence by all members.

8. An advance schedule of meetings will be drawn up by the DSRP and (the state government) and sent to the CWC and the World Bank to allow them to send an observer to meetings if they so desire. The Bank will not participate in any manner in the proceedings and discussions. The CWC will directly participate only to the extent that it serves as a consultant and as so requested by (the state government). The CWC, however, may attend the sessions in the course of fulfilling its responsibilities for monitoring the country-wide dam safety program.

#### Specific Actions

9. The DSRP shall make a general review of the project records and history to become familiar with its operational requirements and their relationship to the facilities. With this background, the specific elements to be reviewed and evaluated by the DSRP shall include, but not be limited to the following:

- (a) as-built drawings and construction specifications;
- (b) design records, including geological reports, foundation investigations, materials testing, materials strength parameters and stability analysis;

- (c) construction records and recent operation and maintenance records, including any instrumentation data;
- (d) criteria, methodology and determination of the design flood, flood routing studies, and the spillway sizing. Examine spillway operation records, and evaluate the adequacy of spillway sizing;
- (e) emergency plans including downstream flooding effects, emergency reservoir drawdown, notification of impending dangers to downstream municipal authorities, major flood early warning system, major flood spilling operations plan, and site access during emergencies.

10. The DSRP will carry out a field inspection utilizing a standardized check-list prepared in advance, and note the condition of the elements on the check list and categorize their status as satisfactory, poor, or unsatisfactory. Additional narrative will be provided for poor and unsatisfactory elements. On the basis of these notes and the design review, the DSRP will make a critical evaluation of actions needed to assure the safety of the dam, categorised in regard to urgency.

11. The DSRP may request additional field data including the need for drilling, sampling, laboratory tests, or installation of instruments.

Support Services

12. (The state government) shall make the operations and maintenance staff of the dam available to respond to the DSRP's questions at the time of the field inspection. As appropriate, the observations of the operators shall become part of the record of the DSRP's report. (The state government)'s designers and engineering consultants, if any, shall be present during selected DSRP meetings. The DSRP will be provided the necessary background information, any relevant data, notes or explanations regarding the designs, computations or methods used. (The state government)'s Chief Engineer for (the project) will coordinate the assembling of such information. The DSRP may suggest additional studies to assist in evaluation of the matters relating to the dam's safety status.

13. (The state government) shall provide clerical, drafting and reproduction services for the preparation of DSRP reports. The GOI and (the state government) shall take necessary actions to allow prompt travel clearance as requested by DSRP members or experts called for the meeting.

Reporting

14. The report of the meeting will be prepared and signed by all members and presented to (the state government) prior to departure of the members. The report will include:

- (a) areas of concern, request for additional analysis and recommendations, if any
  - (a) information presented to the DSRP by (the State);
  - (b) issues raised by the State for consideration by the DSRP;
  - (c) actions taken in response to recommendations of the DSRP;
  - (d) actions pending in response to earlier recommendations of the DSRP

15. A copy of the DSRP's report and supplementary information will be transmitted by (the state government) to the CWC, and the World Bank.

INDIA  
DAM SAFETY PROJECT

EXPANSION OF FLOOD FORECASTING NETWORKS

1. Under the overall flood management policy practices, the Central Water Commission (CWC) is playing a significant role in disaster preparedness and mitigation through its country wide network of 157 flood forecasting stations, out of which 25 stations pertain to inflow forecasting into reservoirs.
2. The Dam Safety Project also proposes to upgrade India's flood forecasting capability by improving the data acquisition system for modernizing the inflow forecasting and by attaining better warning time and inflow information. In the first phase of this program river basins such as the Krishna, the Mahanadi and the Chambal which are inter-state basins will be selected for evaluation of real time data acquisition and inflow forecasting using state of the art data transmission systems and mathematical modelling technology.
3. The existing system in the Krishna and the Mahanadi, maintained and operated by CWC, has a large network of meteorological/hydrological and wireless stations. These stations are yet to be organised into the real time system reducing the manual operation to the minimum. In the case of Chambal basin, the inflow forecasting into the Gandhisagar reservoir is operated and maintained by the Government of Madhya Pradesh with the help of a network of rain gauge/gauge discharge and wireless stations. It is now proposed to modernize these systems by installing real time data acquisition network of stations with advanced sensor technology, micro processor based Data Acquisition System (DAS) coupled with the latest technology of communication. The proposed system would be suitably interfaced with the main computer system in each basin to store, process and interpret the data through mathematical models for issue of real time inflow as well as river level forecasts.
4. The real time stations are called remote stations and are categorized into three groups which include the meteorological stations (MS) to collect data of rainfall and other meteorological parameters, gauge and discharge stations (GD) to collect information on the river level and discharge along with information of silt and water quality at a few selected sites and project stations (PS) at existing structures/projects/gauge sites and also at projects where inflow forecasts are to be issued. It is also proposed to have data of the meteorological parameters not only from the meteorological sites but also from the gauge and discharge sites and the project sites. The program also envisages modernization of the gauge discharge observation technique by introducing state-of-art technology available in this field.

5. In the Krishna basin, it is possible to have 109 remote stations out of which 48 will be M.S. stations, 29 GD stations and 32 PS Stations. The main control center in the basin would be located at Hyderabad/Vijayawada alongwith the computer system. The existing CWC network of 27 G&D stations and 31 meteorological stations be merged into the new system. The inflow forecasting activity which is presently done for six reservoirs might be extended to cover two more reservoirs with the proposed network.

6. In the Mahanadi basin, inflow/river level forecasting is presently carried out for the Hirakud reservoir and to river level stations in the Mahanadi delta with the help of 37 GD and gauge stations, and 31 meteorological stations. It is proposed to modernize the forecasting system in the basin with 84 real time remote stations comprising 35 MS Stations, 37 GD Station, 12 PS Stations. The main control center would be located at Sambalpur/Bhubaneswar along with the computer forecasting activity to cover five additional reservoirs and one river level forecasting site.

7. In the Chambal basin, inflow forecasting is done by the Government of Madhya Pradesh (GOMP) with the help of 13 rain gauge and 14 gauge discharge stations for operating of the Gandhisagar Dam and the cascade of two reservoirs and the barrage downstream. This system is proposed to be completely modernized for real time forecasting to improve the performance of operation of the Gandhisagar Dam and other reservoirs for optimum utilization of storage in the reservoirs. In such new network, it is possible to establish 32 remote stations out of which 13 stations would be MS and 13 GD and 4 PS. The main control centre would be located alongwith computer system at Kota/Udaipur.

8. In order to implement, operate and maintain systems proposed above on a real time basis for inflow and river level forecasting, the organizational structure must be evaluated. The technical staff would be fully supplemented with hydro-meteorological, telemetry and wireless and computer specialists.

9. The cost estimates for the organizational proposals will be prepared. The prevailing costs of various equipment and communication systems as available both indigenously and imported will be considered. The operation and the maintenance of the system will be examined. The Tools & Plants (T&P) estimates take into account the equipment including vehicles etc., to be procured both indigenously and imported. Some of the equipment for the project may have to to be imported. The component of study tours and training would be worked out after consultation with the World Bank.

10. The total equipment component in the project would be about 50% foreign exchange. The custom duty at the prevailing rates for different types of equipment to be imported would be fully accounted for in the estimates.

11. Keeping in view the fact that there is already an organization functioning in some basins, there still may be additional technical and administrative staff needed at the start of the project.

12. In the preliminary proposals submitted in May/June, 1990 and which was

discussed by the pre-appraisal mission of the World Bank, it was envisaged that the project would cover 14 dams and reservoirs for inflow forecasting. It was also proposed to have either the line of sight telemetry or the satellite telemetry communication system for data acquisition and transmission. Later evaluation considered the advantages of the meteor burst communication and its recommendations for adoption in the Narmada basin for a similar project. It was considered desirable to evaluate the same system for other river basins. The pre-appraisal mission of the World Bank had also desired that the staff proposal should be re-examined. In preparing the revised proposals, the new system to be adopted for the Narmada basin, also under World Bank Assistance, will be kept in view.

13. As desired by the World Bank pre-appraisal mission, and subsequent internal GOI review, the requirement of staff has been examined and it is yet to be decided, the mix of existing organization of CWC and state organizations.

INDIA

DAM SAFETY PROJECT

TRAINING, WORKSHOPS AND CONSULTANCY

1. The total provision for training, workshops and consultancy in the Dam Safety Project is of the order of Rs.47 million. This contains a provision of Rs.14 million for Central component and Rs.32 million for the four participating States. Provisions for workshops and training have been made under separate activities, both Central and State. However, this activity will be centrally managed and coordinated. External consultancy for training will be deployed through CWC only.

Central Component

2. The provision under the CWC component of the DSAR Project for training and workshops is as follows:

- (a) Under the Institutional Strengthening portion of the Central Component of the DSAR Project, the provision for Training Seminars and Workshops will be about Rs.8.9 million.

This provision includes:

<u>Item</u>	<u>Estimated cost</u> (in Rs. million)
i. Training of CWC engineers abroad 30 man-months (15 DSO + 15 Hydrology)	2.0
ii. Conducting Training Courses, Seminars and Workshops	2.1
iii. External Consultants 12 man-months (6 DSO + 6 Hydrology)	4.0
iv. Study Tours 8 man-months (4 DSO + 4 Hydrology)	<u>0.8</u>
Sub Total	8.9

- (b) Under Flood Forecasting activity a provision of Rs.6.0 million had been made towards training and external consultancy. Details are yet to be finalised. Total = Rs.14.9 million

State Component

3. The provision under State Component of the DSAR Project for training and workshop is as follows:

<u>Activities</u>	<u>Amount in Rs. million</u>
(a) Training and Workshops	6.0
(b) Panel of Experts for Phase II inspection	10.4
(c) Consultants for Hydrological and Structural Reviews	7.7
(d) Experts for Dam Safety Review Panels	<u>7.6</u>
Total	31.7

Training and Workshops

4. A provision of Rs.4.0 million has been made for deputing two engineers from each of the four participating states for one-and-a-half months' training abroad every year. This is equivalent to 60 man-months of training for state engineers over the project period. A provision of Rs.2.0 million has been made for workshops to be arranged for the four participating states. Though the provision has been split into four statewise estimates it is proposed to hold joint workshops. These workshops would be conducted twice in a year, generally in May and November. Thus, there would be ten workshops during the project period.

5. Workshops in October 1991 and October 1992 would be for procedures, methods and techniques for performing safety inspection of dams. These workshops would be of two weeks' duration and would be conducted by CWC and State engineers. Other workshops would also be conducted by Indian experts/CWC/States and would cover subjects like hydrology, operation and maintenance, periodic inspections, emergency action planning, structural aspects, dam safety procedures, instrumentation, correcting dam safety deficiencies, etc.

Indian Experts/Consultants

6. Indian experts/consultants would be engaged for the following:

- (i) Augmentation of teams for Phase II evaluations;
- (ii) Consultants for hydrological and structural analysis; and
- (iii) Dam Safety Review Panels.

Experts for Phase II Evaluations

7. Where Phase I inspection indicates need for further investigations, the Phase II evaluation would be carried out by state engineering staff augmented with experts. The phase II evaluation team would consist of one to four members. Assuming five visits of the team of three days each, the requirement would be 60 man-days per dam.

Provision has been made for Phase II inspections as under:

	<u>State</u>	<u>Number of Dams</u>	<u>Estimated amount</u> (in Rs. million)
1.	Madhya Pradesh	75	5.3
2.	Orissa	25	1.8
3.	Rajasthan	25	1.8
4.	Tamil Nadu	22	1.5
	Total	147	10.4

Consultants for Hydrological and Structural Review

8. Provisions are included for technical assistance to the states in structural review by utilizing consultants:

<u>State</u>	<u>Hydrological Review</u>	<u>Structural Review</u>	<u>Total Cost</u> (in Rs. millions)	
Madhya Pradesh	95 dams	20 dams	28.75	2.9
Orissa	20 dams	-	7.00	.7
Rajasthan	50 dams	24 dams	37.00	3.7
Tamil Nadu	5 dams	-	4.00	.4
		Total		7.7

Dam Safety Review Panels

9. As per requirement of the World Bank, Dam Safety Review Panels are required to be established for dams where remedial measures are proposed to be undertaken. The DSRP would consist of four to five experts. It is estimated that the DRSPs would spend about 240 man-days for each project.

10. The number of dams proposed for rehabilitation in this project and the project provisions are as under:

<u>State</u>	<u>Number of Dams Proposed for Rehabilitation</u>	<u>Provision for DSRP (in Rs. million)</u>
Madhya Pradesh	8	1.7
Orissa	9	2.2
Rajasthan	7	1.5
Tamil Nadu	<u>9</u>	<u>2.1</u>
Total	<u>33</u>	<u>7.5</u>



INDIA

DAM SAFETY PROJECT

ENVIRONMENTAL IMPACT

1. The initiation and intensification of the Dam Safety Assurance procedures and the performance of remedial action cannot provide an absolute guarantee that there will be no dam failures within the four participating states. The hazards that a dam with a full reservoir pose to inhabitants downstream is most likely to increase in the future as there will be greater populations, more valuable property and other near river bank development that would cause higher stages of flow should a dam fail. The risk associated with dam failure should however be significantly reduced as a result of implementing the project. The increased knowledge of the safety status of the dams by more detailed monitoring and inspection, followed by remedial work to correct deficiencies will over time reduce the risks of failure.

2. The failure of a large dam, particularly one located above densely populated areas as is typical in India, poses an enormous environmental hazard as well as the hazard of loss of life and property. The environmental impact of the project must be considered positive as the primary objective is to upgrade and maintain a higher level of safety of the dams against failure and thus reduce the risks to the public.

3. During the course of carrying out the remedial work on individual sub-project dams, there may be limited positive and negative impacts. For example, the reassessment of the spillway capacity may require the raising of the dam level to accommodate larger than designed for floods. This could cause a negative impact on areas around the reservoir shore-line. Those areas would become subject to inundation during extreme flood events. (Such floods might only be of a return interval of say one in one thousand years and thus only have a slight probability of actually occurring during the life of the project). The same action would however also provide a larger flood storage

capacity that would create positive environmental impacts by allowing greater regulation of large but not extreme floods and reduce the peak flows downstream.

4. The construction work for the basin facilities and for remedial work will largely be confined to the areas immediately in the vicinity of the existing dams. As an example, a contract that requires a foundation grouting or construction of a drain from the toe of the dam will have practically no environmental impact. On the other hand, larger remedial activities such as creating a new access road, or opening a quarry for additional materials to expand a dam, could have some negative impact during the construction period. The environmental impact of such activities is obviously extremely site specific.

5. The states have made a commitment to conduct an inventory of environmental impact potentials as an activity of the sub-project design. Where necessary, an environmental impact analysis will be prepared to assess the extent of any negative impacts and to outline means of mediation. Such environmental impact analysis would be carried out under a terms of reference acceptable to the Bank.

6. Another project activity with a positive environmental impact, is the expansion of guidelines and requirements for each dam to have an emergency action plan. Such plans commonly relate to procedures and instruction for communication and notification. Procedures to warn downstream Civil Defense Authorities in case of large and sudden flood flow releases or for situations where failure of the dam appears eminent. The emergency action plans will be prepared in cooperation with local and state officials and periodically updated to assure that they remain active. The SDSO in each state will help guide the individual project O&M units in preparing such plans and in checking that the information is prominently posted for reference by the dam's operating personnel.

INDIA  
DAM SAFETY PROJECT

MONITORING AND EVALUATION

1. Monitoring and Evaluation (M&E) are intrinsic parts of the project. The project will establish institutional resources and procedures to monitor on a regular basis the safety status of dams in the participating states, and evaluate and take action upon the information so generated.

2. In addition, the functioning of the project and extent to which it is meeting the targets established under India's dam safety assurance procedures would be the subject of specific M&E activities.

Monitoring

3. Within each state, the State Dam Safety Organization would prepare an annual report on its activities, and the findings of inspections carried out during the year. This report would contain the following statistical information :

- (a) number of functioning large dams in state at the end of the year;
- (b) number of Phase I inspections :
  - (i) planned for the year;
  - (ii) started during the year;
  - (iii) completed;
- (c) number of Phase II evaluations :
  - (i) recommended by State Dam Safety Committee during the year;
  - (ii) pending or in progress at the beginning of the year;
  - (iii) completed during the year;
  - (iv) pending at the end of the year;
- (d) agencies and manpower assigned to ongoing Phase II inspections;
- (e) number of flood hydrology review and who is performing them:

- (i) requested during the year;
  - (ii) pending or in progress at the beginning of the year;
  - (iii) completed during the year;
  - (iv) pending at the end of the year;
- (f) breakdown by cause of referrals for Phase II inspection (hydrology, abutments, foundations, etc.)

4. This information provides the basic information for monitoring whether dam safety assurance activities are proceeding according to schedule, or are falling behind. On the basis of this information, the CWC prepares its Annual Report on the project.

#### Evaluation

5. Evaluation of the program would be carried out annually by a sub-committee of the National Committee on Dam Safety together with designated members of each participating state's Dam Safety Committee.

6. The purpose of evaluation is to assess whether the objectives of the Dam Safety Assurance program are being met: the scheduled inspections and reports are a means to improve the safety status of dams, not an end in themselves.

7. The Terms of Reference for the evaluation process would be in two parts: first, an analysis of any factors causing a shortfall in the schedule for completion of Phase I inspection for Phase II investigations. (staff, facilities, non-availability of information, slow response from state, central or other agencies, etc.) State agencies would be encouraged to provide information for this review, and recommend changes to the procedures, agencies involved, and resources provided as appropriate.

8. The second aspect of the evaluation process would focus on the results of inspections, and would include such aspects as: percentage of dams requiring Phase II inspections (categorized by age, type, reason); percentage of "problem" dams being dealt with as a first, and percentage left pending due to lower priority, shortage of funds etc. More detailed analysis of causes of problems would be undertaken to ascertain particular weaknesses in design, materials analysis or other factors which can be related to ongoing and future designs to limit further problems.

**India**  
**Dam Safety Project**  
**Table 1. Madhya Pradesh - Institutional Strengthening**  
**Detailed Cost Table**  
**RS. M**

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Office Furniture	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.10	0.60	0.02	EQ
B. Vehicles	0.3	1.0	0.0	0.0	0.0	0.0	1.3	0.10	0.60	0.02	EQ
C. Equipment	0.5	2.0	3.0	0.0	0.0	0.0	5.5	0.10	0.60	0.02	EQ
D. Consultants	0.8	0.8	0.8	0.8	0.8	0.8	4.8	0.10	0.20	0.00	TTC
E. Training	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>2.4</b>	<b>4.3</b>	<b>4.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>14.9</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Staff	3.0	4.0	5.6	5.6	5.6	4.0	27.8	0.00	0.00	0.00	IS
B. Incremental Oper. Exp.	0.5	0.6	0.7	0.7	0.7	0.7	3.9	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>3.5</b>	<b>4.6</b>	<b>6.3</b>	<b>6.3</b>	<b>6.3</b>	<b>4.7</b>	<b>31.7</b>				
<b>Total</b>	<b>5.9</b>	<b>8.9</b>	<b>10.6</b>	<b>7.6</b>	<b>7.6</b>	<b>6.0</b>	<b>46.6</b>				

- Values scaled by 1000000.0 4/18/1991 9:29

**India**  
**Dam Safety Project**  
**Table 2. Madhya Pradesh - Basic Safety Facilities**  
**Detailed Cost Table**  
**RS. M**

	Base Costs							Parameters		
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax Sum. Acnt.
<b>I. INVESTMENT COSTS</b>										
A. Access Roads	23.6	23.6	22.5	21.4	21.4	15.0	127.5	0.20	0.08	0.02 CW
B. Communication System	1.6	1.6	1.5	1.4	1.4	0.0	7.5	0.10	0.60	0.02 EQ
C. Diesel Generator Sets	1.1	1.1	1.0	1.0	1.0	1.0	6.2	0.10	0.60	0.02 EQ
D. Instruments	5.2	5.2	4.9	4.7	4.7	3.0	27.7	0.10	0.60	0.02 EQ
E. Emergency Stock Piles	0.4	0.4	0.4	0.4	0.4	0.3	2.3	0.10	0.60	0.02 EQ
F. Supervision & Admin.	0.6	0.6	0.4	0.3	0.3	0.3	2.5	0.10	0.05	0.00 DSA
G. Land	0.2	0.2	0.2	0.0	0.0	0.0	0.6	0.05	0.00	0.00 LA
<b>Total INVESTMENT COSTS</b>	<b>32.7</b>	<b>32.7</b>	<b>30.9</b>	<b>29.2</b>	<b>29.2</b>	<b>19.6</b>	<b>174.3</b>			
<b>II. RECURRENT COSTS</b>										
A. Incremental Oper. Exp.	3.6	3.6	3.6	3.6	3.6	3.0	21.0	0.00	0.05	0.00 IOE
<b>Total RECURRENT COSTS</b>	<b>3.6</b>	<b>3.6</b>	<b>3.6</b>	<b>3.6</b>	<b>3.6</b>	<b>3.0</b>	<b>21.0</b>			
<b>Total</b>	<b>36.3</b>	<b>36.3</b>	<b>34.5</b>	<b>32.8</b>	<b>32.8</b>	<b>22.6</b>	<b>195.3</b>			

- Values scaled by 1000000.0 4/18/1991 9:29

India  
 Dam Safety Project  
 Table 3. Madhra Pradesh - Remedial Works  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Civil Works - Dams	50.9	112.8	139.6	135.4	100.5	85.0	624.2	0.20	0.08	0.02	CW
B. Supervision & Admin.	4.8	10.7	13.3	12.9	9.5	8.1	59.3	0.10	0.05	0.00	DSA
C. Design	2.0	4.5	5.6	5.4	4.0	3.4	25.0	0.10	0.05	0.00	DSA
D. Consultants	1.4	1.4	1.4	0.5	0.5	0.5	5.7	0.10	0.20	0.00	TTC
E. Dam Safety Review Panel	0.4	0.4	0.3	0.3	0.2	0.2	1.9	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>59.6</b>	<b>129.9</b>	<b>160.2</b>	<b>154.6</b>	<b>114.7</b>	<b>97.2</b>	<b>716.1</b>				
<b>Total</b>	<b>59.6</b>	<b>129.9</b>	<b>160.2</b>	<b>154.6</b>	<b>114.7</b>	<b>97.2</b>	<b>716.1</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 4. Orissa - Institutional Strengthening  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Office Furniture	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.10	0.60	0.02	EQ
B. Vehicles	0.5	0.5	1.0	0.0	0.0	0.0	2.0	0.10	0.60	0.02	EQ
C. Equipment	0.5	2.0	2.0	0.0	0.0	0.0	4.5	0.10	0.60	0.02	EQ
D. Consultants	0.8	0.8	0.8	0.8	0.8	0.8	4.8	0.10	0.20	0.00	TTC
E. Training	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>2.6</b>	<b>3.8</b>	<b>4.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>14.6</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Staff	2.7	3.6	4.3	4.3	4.3	3.5	22.7	0.00	0.00	0.00	IS
B. Incremental Oper. Exp.	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>2.8</b>	<b>3.7</b>	<b>4.4</b>	<b>4.4</b>	<b>4.4</b>	<b>3.6</b>	<b>23.5</b>				
<b>Total</b>	<b>5.4</b>	<b>7.5</b>	<b>8.7</b>	<b>5.7</b>	<b>5.7</b>	<b>4.9</b>	<b>38.1</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 5. Orissa - Basic Safety Facilities  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Approach Roads	10.4	10.4	3.4	3.4	3.4	3.0	34.0	0.20	0.08	0.02	CW
B. Wireless Communication	0.5	0.5	0.2	0.2	0.2	0.0	1.6	0.10	0.60	0.02	EQ
C. Standby Power	3.3	3.3	1.1	1.1	1.1	0.5	10.4	0.10	0.60	0.02	EQ
D. Instrumentation	2.5	2.5	0.8	0.8	0.8	0.6	8.0	0.10	0.60	0.02	EQ
E. Flood Forecasting/Warning	5.0	5.0	1.6	1.6	1.6	0.0	14.8	0.10	0.60	0.02	EQ
F. Supervision & Admin.	0.4	0.4	0.2	0.2	0.2	0.2	1.8	0.10	0.05	0.00	DSA
G. Land	0.2	0.2	0.1	0.0	0.0	0.0	0.5	0.05	0.00	0.00	LA
<b>Total INVESTMENT COSTS</b>	<b>22.3</b>	<b>22.3</b>	<b>7.4</b>	<b>7.3</b>	<b>7.3</b>	<b>4.3</b>	<b>70.9</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Oper. Exp.	5.0	5.0	5.0	5.0	5.0	4.0	29.0	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	<b>4.0</b>	<b>29.0</b>				
<b>Total</b>	<b>27.3</b>	<b>27.3</b>	<b>12.4</b>	<b>12.3</b>	<b>12.3</b>	<b>8.3</b>	<b>99.9</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 6. Orissa - Remedial Works  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Civil Works - Dams	26.8	47.2	151.0	150.0	150.0	98.8	623.8	0.20	0.08	0.02	CW
B. Supervision & Admin.	2.5	4.5	14.3	14.2	14.2	9.4	59.3	0.10	0.05	0.00	DSA
C. Design	1.1	1.9	6.0	6.0	6.0	4.0	25.0	0.10	0.05	0.00	DSA
D. Consultants	3.0	1.8	1.8	1.0	0.5	0.5	8.6	0.10	0.20	0.00	TTC
E. Dam Safety Review Panel	0.5	0.5	0.4	0.4	0.2	0.2	2.4	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>33.9</b>	<b>55.9</b>	<b>173.6</b>	<b>171.7</b>	<b>171.0</b>	<b>112.9</b>	<b>719.0</b>				
<b>Total</b>	<b>33.9</b>	<b>55.9</b>	<b>173.6</b>	<b>171.7</b>	<b>171.0</b>	<b>112.9</b>	<b>719.0</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 7. Tamilnadu - Institutional Strengthening  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Office Furniture	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.10	0.60	0.02	EQ
B. Vehicles	0.2	0.8	0.0	0.0	0.0	0.0	1.0	0.10	0.60	0.02	EQ
C. Equipment	0.6	2.0	2.0	0.0	0.0	0.0	4.6	0.10	0.60	0.02	EQ
D. Consultants	0.8	0.8	0.8	0.8	0.8	0.8	4.8	0.10	0.20	0.00	TTC
E. Training	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>2.3</b>	<b>4.1</b>	<b>3.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>13.7</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Staff	2.0	2.7	3.4	3.4	3.4	3.0	17.9	0.00	0.00	0.00	IS
B. Incremental Oper. Exp.	0.4	0.5	0.6	0.6	0.6	0.5	3.2	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>2.4</b>	<b>3.2</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>3.5</b>	<b>21.1</b>				
<b>Total</b>	<b>4.7</b>	<b>7.3</b>	<b>7.3</b>	<b>5.3</b>	<b>5.3</b>	<b>4.8</b>	<b>34.8</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

**India**  
**Dam Safety Project**  
**Table 8. Tamilnadu - Basic Safety Facilities**  
**Detailed Cost Table**  
**RS. M**

	Base Costs							Parameters				
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.	
<b>I. INVESTMENT COSTS</b>												
A. Roads, Commun., Power	7.0	8.3	7.0	1.2	1.2	1.0	25.7	0.20	0.08	0.02	CW	
B. Instrumentation	2.0	3.0	2.2	0.4	0.4	0.4	8.4	0.10	0.60	0.02	EQ	
C. Flood Forecasting/Warning	2.0	3.5	3.5	0.5	0.5	0.0	10.0	0.10	0.60	0.02	EQ	
D. Supervision & Admin.	0.4	0.4	0.3	0.2	0.1	0.1	1.5	0.10	0.05	0.00	DSA	
E. Land	0.2	0.2	0.0	0.0	0.0	0.0	0.4	0.05	0.00	0.00	LA	
<b>Total INVESTMENT COSTS</b>	<b>11.6</b>	<b>15.4</b>	<b>13.0</b>	<b>2.3</b>	<b>2.2</b>	<b>1.5</b>	<b>46.0</b>					
<b>II. RECURRENT COSTS</b>												
A. Incremental Oper. Exp.	2.6	2.6	2.6	2.6	2.6	2.0	14.9	0.00	0.05	0.00	IOE	
<b>Total RECURRENT COSTS</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>2.0</b>	<b>14.9</b>					
<b>Total</b>	<b>14.2</b>	<b>18.0</b>	<b>15.6</b>	<b>4.9</b>	<b>4.8</b>	<b>3.5</b>	<b>60.9</b>					

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 9. Tamilnadu - Remedial Works  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Civil Works - Dams	21.3	47.8	74.8	72.6	65.4	52.2	334.1	0.20	0.08	0.02	CW
B. Supervision & Admin.	2.6	4.5	7.1	6.9	6.2	5.0	31.7	0.10	0.05	0.00	DSA
C. Design	0.9	1.9	3.0	2.9	2.6	2.1	13.4	0.10	0.00	0.00	DSA
D. Consultants	1.0	1.0	1.0	1.0	1.0	1.0	6.0	0.10	0.20	0.00	TTC
E. Dam Safety Review Panel	0.5	0.5	0.4	0.4	0.2	0.2	2.4	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>25.7</b>	<b>55.8</b>	<b>86.3</b>	<b>83.8</b>	<b>75.5</b>	<b>60.4</b>	<b>387.6</b>				
<b>Total</b>	<b>25.7</b>	<b>55.8</b>	<b>86.3</b>	<b>83.8</b>	<b>75.5</b>	<b>60.4</b>	<b>387.6</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 10. Rajasthan - Institutional Strengthening  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters				
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy.	Cont.	For. Exch.	Gross Tax Sum.	Acnt.
<b>I. INVESTMENT COSTS</b>												
A. Office Furniture	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.10		0.60	0.02	EQ
B. Vehicles	0.2	1.0	0.0	0.0	0.0	0.0	1.2	0.10		0.60	0.02	EQ
C. Equipment	0.5	2.0	3.1	0.0	0.0	0.0	5.6	0.10		0.60	0.02	EQ
D. Consultants	0.8	0.8	0.8	0.8	0.8	0.8	4.8	0.10		0.20	0.00	TTC
E. Training	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.10		0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>2.3</b>	<b>4.3</b>	<b>4.4</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>14.9</b>					
<b>II. RECURRENT COSTS</b>												
A. Incremental Staff	2.3	3.1	3.9	3.9	3.9	3.5	20.6	0.00		0.00	0.00	IS
B. Incremental Oper. Exp.	0.9	0.9	0.9	0.9	0.9	0.8	5.4	0.00		0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>3.2</b>	<b>4.0</b>	<b>4.8</b>	<b>4.8</b>	<b>4.8</b>	<b>4.3</b>	<b>26.0</b>					
<b>Total</b>	<b>5.5</b>	<b>8.3</b>	<b>9.2</b>	<b>6.1</b>	<b>6.1</b>	<b>5.6</b>	<b>40.9</b>					

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 11. Rajasthan - Basic Safety Facilities  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Obser. & Measuring Points	1.5	5.5	2.6	0.7	0.7	0.5	11.5	0.10	0.60	0.02	EQ
B. Access Roads	2.2	7.8	3.7	0.9	0.9	0.7	16.2	0.20	0.08	0.02	CW
C. Bridges & Culverts	0.9	3.1	1.5	0.4	0.4	0.1	6.4	0.20	0.08	0.02	CW
D. Wireless Communication	0.8	3.0	1.4	0.4	0.4	0.1	6.1	0.10	0.60	0.02	EQ
E. Standby Power	0.4	1.3	0.6	0.2	0.2	0.2	2.9	0.10	0.60	0.02	EQ
F. Flood Forecasting System	1.9	6.8	3.2	0.8	0.8	0.0	13.5	0.10	0.60	0.02	EQ
G. Supervision & Admin.	0.4	0.8	0.4	0.2	0.1	0.1	2.0	0.10	0.05	0.00	DSA
H. Land	0.2	0.2	0.0	0.0	0.0	0.0	0.4	0.05	0.00	0.00	LA
<b>Total INVESTMENT COSTS</b>	<b>8.3</b>	<b>28.5</b>	<b>13.4</b>	<b>3.6</b>	<b>3.5</b>	<b>1.7</b>	<b>59.0</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Oper. Exp.	4.0	4.0	4.0	4.0	4.0	3.5	23.5	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>3.5</b>	<b>23.5</b>				
<b>Total</b>	<b>12.3</b>	<b>32.5</b>	<b>17.4</b>	<b>7.6</b>	<b>7.5</b>	<b>5.2</b>	<b>82.5</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 12. Rajasthan - Remedial Works  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters						
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy.	Cont.	For.	Exch.	Gross Tax	Sum.	Acnt.
<b>I. INVESTMENT COSTS</b>														
A. Civil Works - Dams	12.2	28.7	90.4	100.4	99.5	61.0	392.2	0.20			0.08	0.02	CW	
B. Supervision & Admin.	1.2	2.7	8.6	9.5	9.5	5.8	37.3	0.10			0.05	0.00	DSA	
C. Design	0.5	1.1	3.6	4.0	4.0	2.4	15.7	0.10			0.05	0.00	DSA	
D. Consultants	2.1	2.1	7.0	1.0	1.0	1.0	14.2	0.10			0.20	0.00	TTC	
E. Dam Safety Review Panel	0.4	0.4	0.3	0.3	0.2	0.2	1.8	0.10			0.20	0.00	TTC	
<b>Total INVESTMENT COSTS</b>	<b>16.3</b>	<b>35.1</b>	<b>109.9</b>	<b>115.3</b>	<b>114.1</b>	<b>70.4</b>	<b>461.1</b>							
<b>Total</b>	<b>16.3</b>	<b>35.1</b>	<b>109.9</b>	<b>115.3</b>	<b>114.1</b>	<b>70.4</b>	<b>461.1</b>							

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 13. Dam Safety Organization  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Equipment	0.4	0.4	0.0	0.0	0.0	0.0	0.9	0.10	0.60	0.02	EQ
B. Furniture	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.10	0.60	0.02	EQ
C. Training	0.9	1.1	0.6	0.3	0.2	0.2	3.4	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>1.7</b>	<b>1.5</b>	<b>0.6</b>	<b>0.3</b>	<b>0.2</b>	<b>0.2</b>	<b>4.6</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Staff	1.6	2.0	2.7	2.7	2.7	2.3	14.0	0.00	0.00	0.00	IS
B. Incremental Oper. Exp.	0.4	0.5	0.6	0.6	0.6	0.5	3.2	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>2.0</b>	<b>2.5</b>	<b>3.3</b>	<b>3.3</b>	<b>3.3</b>	<b>2.8</b>	<b>17.2</b>				
<b>Total</b>	<b>3.7</b>	<b>4.0</b>	<b>3.9</b>	<b>3.6</b>	<b>3.5</b>	<b>3.0</b>	<b>21.8</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

**India**  
**Dam Safety Project**  
**Table 14. Hydrology Organization**  
**Detailed Cost Table**  
**RS. M**

	Base Costs							Parameters			
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy. Cont.	For. Exch.	Gross Tax	Sum. Acnt.
<b>I. INVESTMENT COSTS</b>											
A. Equipment	0.6	0.6	0.0	0.0	0.0	0.0	1.2	0.10	0.60	0.02	EQ
B. Furniture	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.10	0.60	0.02	EQ
C. Training	1.3	1.5	0.9	0.4	0.2	0.2	4.5	0.10	0.20	0.00	TTC
D. PMP Charts by IMD	2.5	2.5	2.5	0.0	0.0	0.0	7.5	0.10	0.20	0.00	TTC
E. Consultants	0.8	0.8	0.8	1.0	1.0	0.8	5.3	0.10	0.20	0.00	TTC
<b>Total INVESTMENT COSTS</b>	<b>5.4</b>	<b>5.5</b>	<b>4.2</b>	<b>1.4</b>	<b>1.2</b>	<b>1.0</b>	<b>18.8</b>				
<b>II. RECURRENT COSTS</b>											
A. Incremental Staff	1.6	1.8	2.1	2.1	2.1	1.8	11.5	0.00	0.00	0.00	IS
B. Incremental Oper. Exp.	0.5	0.5	0.3	0.3	0.3	0.2	2.1	0.00	0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>2.1</b>	<b>2.3</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>2.0</b>	<b>13.6</b>				
<b>Total</b>	<b>7.5</b>	<b>7.8</b>	<b>6.6</b>	<b>3.8</b>	<b>3.6</b>	<b>3.0</b>	<b>32.4</b>				

- Values scaled by 1000000.0 4/18/1991 9:30

India  
 Dam Safety Project  
 Table 15. Flood Forecasting System  
 Detailed Cost Table  
 RS. M

	Base Costs							Parameters				
	91/92	92/93	93/94	94/95	95/96	96/97	Total	Phy.	Cont.	For. Exch.	Gross Tax Sum.	Acnt.
<b>I. INVESTMENT COSTS</b>												
A. Civil Works	0.0	3.0	3.0	3.0	3.0	0.0	12.0	0.20		0.08	0.02	CW
B. Land	0.5	0.5	0.5	0.0	0.0	0.0	1.5	0.05		0.00	0.00	LA
C. Furniture & Office Equip.	0.0	0.0	0.5	0.5	0.0	0.0	1.0	0.10		0.90	0.02	EQ
D. Field Equipment	0.0	3.0	3.0	2.0	2.0	0.0	10.0	0.10		0.60	0.10	EQ
E. Boats & Vehicles	0.0	0.0	2.0	1.0	0.0	0.0	3.0	0.10		0.60	0.02	EQ
F. Main Data Comm. Equipment	10.0	13.0	15.0	22.0	29.8	22.0	111.8	0.10		0.50	0.50	EQ
G. Training	0.0	2.0	2.0	0.5	0.5	0.5	5.5	0.10		0.20	0.00	TTC
H. Supervision & Admins.	0.5	0.5	0.7	0.7	0.5	0.5	3.4	0.10		0.05	0.00	DSA
<b>Total INVESTMENT COSTS</b>	<b>11.0</b>	<b>22.0</b>	<b>26.7</b>	<b>29.7</b>	<b>35.8</b>	<b>23.0</b>	<b>148.2</b>					
<b>II. RECURRENT COSTS</b>												
A. Incremental Staff	0.0	0.0	1.1	1.1	1.1	1.1	4.4	0.00		0.00	0.00	IS
B. Incremental Oper. Exp.	0.0	0.0	2.1	2.1	2.1	2.1	8.4	0.00		0.05	0.00	IOE
<b>Total RECURRENT COSTS</b>	<b>0.0</b>	<b>0.0</b>	<b>3.2</b>	<b>3.2</b>	<b>3.2</b>	<b>3.2</b>	<b>12.8</b>					
<b>Total</b>	<b>11.0</b>	<b>22.0</b>	<b>29.9</b>	<b>32.9</b>	<b>39.0</b>	<b>26.2</b>	<b>161.0</b>					

- Values scaled by 1000000.0 4/18/1991 9:30

**India  
Dam Safety Project  
Project Cost Summary**

	RS. M			US\$ M			% Foreign Exchange	% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total		
<b>A. GOI/CWC Activities</b>								
1. Institutional Strengthen.	48.2	6.0	54.2	2.7	0.3	3.0	11.0	1.7
2. Flood Forecasting Systems	93.7	67.2	161.0	5.2	3.7	8.9	41.8	5.2
<b>Sub-Total</b>	<b>141.9</b>	<b>73.2</b>	<b>215.2</b>	<b>7.9</b>	<b>4.1</b>	<b>12.0</b>	<b>34.0</b>	<b>6.9</b>
<b>B. States Instit. Strength.</b>								
1. Madhya Pradesh	40.6	6.0	46.6	2.3	0.3	2.6	12.9	1.5
2. Orissa	32.4	5.7	38.1	1.8	0.3	2.1	14.9	1.2
3. Rajasthan	34.8	6.1	40.9	1.9	0.3	2.3	14.9	1.3
4. Tamil Nadu	29.5	5.3	34.8	1.6	0.3	1.9	15.1	1.1
<b>Sub-Total</b>	<b>137.4</b>	<b>23.0</b>	<b>160.4</b>	<b>7.6</b>	<b>1.3</b>	<b>8.9</b>	<b>14.4</b>	<b>5.2</b>
<b>C. States Basic Safety Fac.</b>								
1. Madhya Pradesh	157.7	37.6	195.3	8.8	2.1	10.8	19.2	6.3
2. Orissa	74.8	25.1	99.9	4.2	1.4	5.5	25.2	3.2
3. Rajasthan	59.0	23.5	82.5	3.3	1.3	4.6	28.5	2.7
4. Tamil Nadu	47.0	13.9	60.9	2.6	0.8	3.4	22.9	2.0
<b>Sub-Total</b>	<b>338.5</b>	<b>100.1</b>	<b>438.6</b>	<b>18.8</b>	<b>5.6</b>	<b>24.4</b>	<b>22.8</b>	<b>14.2</b>
<b>D. States Remedial Works</b>								
1. Madhya Pradesh	660.4	55.7	716.1	36.7	3.1	39.8	7.8	23.1
2. Orissa	662.7	56.3	719.0	36.8	3.1	39.9	7.8	23.2
3. Rajasthan	423.9	37.2	461.1	23.6	2.1	25.6	8.1	14.9
4. Tamil Nadu	357.6	30.0	387.6	19.9	1.7	21.5	7.7	12.5
<b>Sub-Total</b>	<b>2104.6</b>	<b>179.2</b>	<b>2283.9</b>	<b>116.9</b>	<b>10.0</b>	<b>126.9</b>	<b>7.8</b>	<b>73.7</b>
<b>Total BASELINE COSTS</b>	<b>2722.4</b>	<b>375.6</b>	<b>3098.0</b>	<b>151.2</b>	<b>20.9</b>	<b>172.1</b>	<b>12.1</b>	<b>100.0</b>
Physical Contingencies	451.3	54.6	505.8	25.1	3.0	28.1	10.8	16.3
Price Contingencies	778.7	177.3	956.1	-5.9	2.5	-3.4	0.0	0.0
<b>Total PROJECTS COSTS</b>	<b>3952.4</b>	<b>607.5</b>	<b>4559.9</b>	<b>170.4</b>	<b>26.4</b>	<b>196.8</b>	<b>13.4</b>	<b>114.3</b>

Values Scaled by 1000000.0 - 4/18/1991 9:31

**India  
Dam Safety Project  
Summary Accounts Cost Summary**

	RS. M			US\$ M			% Foreign Exchange	% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total		
<b>I. INVESTMENT COSTS</b>								
A. Civil Works	2020.4	175.7	2196.1	112.2	9.8	122.0	8.0	70.9
B. Equipment	125.4	160.8	286.2	7.0	8.9	15.9	56.2	9.2
C. Land Acquisition	3.4	0.0	3.4	0.2	0.0	0.2	0.0	0.1
D. Training, TA, Consultants	80.4	20.1	100.5	4.5	1.1	5.6	20.0	3.2
E. Design, Supervis.& Admin.	264.3	13.2	277.5	14.7	0.7	15.4	4.8	9.0
<b>Total INVESTMENT COSTS</b>	<b>2493.9</b>	<b>369.8</b>	<b>2863.7</b>	<b>138.5</b>	<b>20.5</b>	<b>159.1</b>	<b>12.9</b>	<b>92.4</b>
<b>II. RECURRENT COSTS</b>								
A. Incremental Staff	118.9	0.0	118.9	6.6	0.0	6.6	0.0	3.8
B. Incremental Oper. Exp.	109.7	5.8	115.4	6.1	0.3	6.4	5.0	3.7
<b>Total RECURRENT COSTS</b>	<b>228.6</b>	<b>5.8</b>	<b>234.3</b>	<b>12.7</b>	<b>0.3</b>	<b>13.0</b>	<b>2.5</b>	<b>7.6</b>
<b>Total BASELINE COSTS</b>	<b>2722.4</b>	<b>375.6</b>	<b>3098.0</b>	<b>151.2</b>	<b>20.9</b>	<b>172.1</b>	<b>12.1</b>	<b>100.0</b>
Physical Contingencies	451.3	54.6	505.8	25.1	3.0	28.1	10.8	16.3
Price Contingencies	778.7	177.3	956.1	-5.9	2.5	-3.4	0.0	0.0
<b>Total PROJECTS COSTS</b>	<b>3952.4</b>	<b>607.5</b>	<b>4559.9</b>	<b>170.4</b>	<b>26.4</b>	<b>196.8</b>	<b>13.4</b>	<b>114.3</b>

Values Scaled by 1000000.0 - 4/18/1991 9:31

India  
Dam Safety Project  
Summary Account by Project Component  
RS. M

	Institutional Strengthening	Flood Forecasting Systems	Institutional Strengthening				Basic Safety Facilities				Remedial Works				Total	Physical Contingencies		Price Contingencies	
			Madhya Pradesh	Orissa	Rajasthan	Tamil Nadu	Madhya Pradesh	Orissa	Rajasthan	Tamil Nadu	Madhya Pradesh	Orissa	Rajasthan	Tamil Nadu		%	Amount	%	Amount
<b>I. INVESTMENT COSTS</b>																			
A. Civil Works	0.0	12.0	0.0	0.0	0.0	0.0	127.5	34.0	22.8	25.7	624.2	623.8	392.2	334.1	2196.1	20.0	433.2	81.4	688.5
B. Equipment	2.8	125.8	7.1	8.8	7.1	5.9	43.7	34.8	34.0	18.4	0.0	0.0	0.0	0.0	286.2	10.0	28.6	37.8	106.1
C. Land Acquisition	0.0	1.5	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.4	0.0	0.0	0.0	0.0	3.4	5.0	0.2	10.4	0.4
D. Training, TA, Consultants	20.8	5.5	7.8	7.8	7.8	7.8	0.0	0.0	0.0	0.0	7.6	11.0	16.0	8.4	100.5	10.0	10.0	24.6	26.7
E. Design, Supervis.& Admin.	0.0	3.4	0.0	0.0	0.0	0.0	2.5	1.6	2.0	1.5	64.3	64.2	52.9	45.1	277.5	10.0	27.8	28.4	78.9
<b>Total INVESTMENT COSTS</b>	<b>23.4</b>	<b>148.2</b>	<b>14.9</b>	<b>14.6</b>	<b>14.9</b>	<b>13.7</b>	<b>174.3</b>	<b>70.9</b>	<b>59.0</b>	<b>46.0</b>	<b>716.1</b>	<b>719.0</b>	<b>461.1</b>	<b>337.6</b>	<b>2869.7</b>	<b>17.7</b>	<b>506.8</b>	<b>81.4</b>	<b>908.6</b>
<b>II. RECURRENT COSTS</b>																			
A. Incremental Staff	26.5	4.4	27.8	22.7	20.8	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.9	0.0	0.0	23.9	23.4
B. Incremental Oper. Exp.	5.3	8.4	3.9	0.8	5.4	3.2	21.0	29.0	23.5	14.9	0.0	0.0	0.0	0.0	115.4	0.0	0.0	23.4	27.1
<b>Total RECURRENT COSTS</b>	<b>30.8</b>	<b>12.8</b>	<b>31.7</b>	<b>23.5</b>	<b>26.0</b>	<b>21.1</b>	<b>21.0</b>	<b>29.0</b>	<b>23.5</b>	<b>14.9</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>234.3</b>	<b>0.0</b>	<b>0.0</b>	<b>23.7</b>	<b>55.5</b>
<b>Total BASELINE COSTS</b>	<b>54.2</b>	<b>161.0</b>	<b>46.6</b>	<b>38.1</b>	<b>40.9</b>	<b>34.8</b>	<b>195.3</b>	<b>99.9</b>	<b>82.5</b>	<b>60.9</b>	<b>716.1</b>	<b>719.0</b>	<b>461.1</b>	<b>337.6</b>	<b>3098.0</b>	<b>16.3</b>	<b>506.8</b>	<b>30.9</b>	<b>968.1</b>
Physical Contingencies	2.3	15.9	1.5	1.5	1.5	1.4	20.1	10.5	8.1	7.1	134.0	134.3	85.3	72.2	605.8				
Price Contingencies	11.8	73.2	11.5	9.4	10.1	8.8	54.7	23.1	19.2	13.1	209.0	237.8	154.4	120.3	958.1	14.0	134.0		
<b>Total PROJECT COSTS</b>	<b>68.3</b>	<b>250.1</b>	<b>59.6</b>	<b>48.9</b>	<b>52.5</b>	<b>44.8</b>	<b>280.2</b>	<b>133.4</b>	<b>109.8</b>	<b>81.1</b>	<b>1059.1</b>	<b>1091.0</b>	<b>700.9</b>	<b>580.1</b>	<b>4559.9</b>	<b>14.0</b>	<b>639.8</b>	<b>21.0</b>	<b>968.1</b>
Taxes	0.1	92.5	0.2	0.2	0.2	0.2	5.0	1.9	1.6	1.2	18.7	19.2	12.1	10.1	163.1	12.2	19.9		
Foreign Exchange	8.4	108.1	8.7	8.2	8.8	7.6	58.7	36.2	33.8	20.0	94.3	96.3	64.8	51.6	607.5	12.8	77.6		

Values Scaled by 1000000.0 4/18/1991 9:31

**India  
Dam Safety Project  
Summary Accounts by Year**

	Totals Including Contingencies RS. M							Totals Including Contingencies US\$ M						
	91/92	92/93	93/94	94/95	95/96	96/97	Total	91/92	92/93	93/94	94/95	95/96	96/97	Total
<b>I. INVESTMENT COSTS</b>														
A. Civil Works	194.7	393.8	713.2	748.0	728.0	548.2	3323.8	9.7	18.5	31.8	31.8	29.6	21.6	142.9
B. Equipment	53.8	94.0	81.3	62.7	78.6	52.5	422.9	2.7	4.4	3.6	2.7	3.2	2.1	18.6
C. Land Acquisition	1.4	1.5	1.0	0.0	0.0	0.0	3.9	0.1	0.1	0.0	0.0	0.0	0.0	0.2
D. Training, TA, Consultants	23.5	26.7	33.2	17.9	16.6	17.4	135.3	1.2	1.3	1.5	0.8	0.7	0.7	6.0
E. Design, Supervis.& Admin.	19.8	42.5	83.2	88.6	85.0	65.1	384.2	1.0	2.0	3.7	3.8	3.5	2.6	16.5
<b>Total INVESTMENT COSTS</b>	<b>293.3</b>	<b>558.6</b>	<b>911.8</b>	<b>917.1</b>	<b>906.1</b>	<b>683.2</b>	<b>4270.1</b>	<b>14.6</b>	<b>26.2</b>	<b>40.7</b>	<b>38.9</b>	<b>36.9</b>	<b>27.0</b>	<b>184.2</b>
<b>II. RECURRENT COSTS</b>														
A. Incremental Staff	13.7	19.1	27.3	29.1	30.9	27.3	147.3	0.7	0.9	1.2	1.2	1.3	1.1	6.4
B. Incremental Oper. Exp.	18.8	20.5	24.5	26.1	27.7	25.0	142.5	0.9	1.0	1.1	1.1	1.1	1.0	6.2
<b>Total RECURRENT COSTS</b>	<b>32.5</b>	<b>39.6</b>	<b>51.8</b>	<b>55.1</b>	<b>58.6</b>	<b>52.3</b>	<b>289.8</b>	<b>1.6</b>	<b>1.9</b>	<b>2.3</b>	<b>2.3</b>	<b>2.4</b>	<b>2.1</b>	<b>12.6</b>
<b>Total PROJECT COSTS</b>	<b>325.8</b>	<b>598.1</b>	<b>963.6</b>	<b>972.2</b>	<b>964.7</b>	<b>735.4</b>	<b>4559.9</b>	<b>16.2</b>	<b>28.1</b>	<b>43.0</b>	<b>41.3</b>	<b>39.3</b>	<b>29.0</b>	<b>196.8</b>

Values Scaled by 1000000.0 4/18/1991 9:31

**India  
Dam Safety Project  
Projects Components by Year**

**Totals Including Contingencies  
RS. M**

**Totals Including Contingencies  
US\$ M**

	Totals Including Contingencies RS. M							Totals Including Contingencies US\$ M						
	91/92	92/93	93/94	94/95	95/96	96/97	Total	91/92	92/93	93/94	94/95	95/96	96/97	Total
<b>A. GOI/CWC Activities</b>														
1. Institutional Strengthen.	12.6	14.2	18.2	9.7	9.7	8.8	68.3	0.6	0.7	0.6	0.4	0.4	0.3	3.0
2. Flood Forecasting Systems	13.6	29.5	42.5	51.3	66.0	47.1	250.1	0.7	1.4	1.9	2.2	2.7	1.9	10.7
<b>Sub-Total</b>	<b>26.3</b>	<b>43.7</b>	<b>55.8</b>	<b>61.0</b>	<b>75.7</b>	<b>55.9</b>	<b>318.4</b>	<b>1.3</b>	<b>2.0</b>	<b>2.5</b>	<b>2.6</b>	<b>3.1</b>	<b>2.2</b>	<b>13.7</b>
<b>B. States Instit. Strength.</b>														
1. Madhya Pradesh	6.5	10.7	13.4	9.8	10.4	8.8	59.6	0.3	0.5	0.6	0.4	0.4	0.3	2.6
2. Orissa	6.0	9.1	11.2	7.4	7.9	7.3	48.9	0.3	0.4	0.5	0.3	0.3	0.3	2.1
3. Rajasthan	6.1	10.0	11.8	7.9	8.4	8.2	52.5	0.3	0.5	0.5	0.3	0.3	0.3	2.3
4. Tamil Nadu	5.3	8.9	9.3	6.9	7.3	7.1	44.8	0.3	0.4	0.4	0.3	0.3	0.3	2.0
<b>Sub-Total</b>	<b>23.8</b>	<b>38.7</b>	<b>45.8</b>	<b>32.1</b>	<b>34.1</b>	<b>31.4</b>	<b>205.9</b>	<b>1.2</b>	<b>1.8</b>	<b>2.0</b>	<b>1.4</b>	<b>1.4</b>	<b>1.2</b>	<b>9.0</b>
<b>C. States Basic Safety Fac.</b>														
1. Madhya Pradesh	44.3	47.6	48.4	49.2	52.4	38.2	280.2	2.2	2.2	2.2	2.1	2.1	1.5	12.3
2. Orissa	32.6	35.1	16.5	17.5	18.6	13.2	133.4	1.6	1.6	0.7	0.7	0.8	0.5	6.0
3. Rajasthan	14.3	42.1	23.8	10.6	11.1	8.0	109.8	0.7	2.0	1.1	0.4	0.5	0.3	5.0
4. Tamil Nadu	17.0	23.3	21.6	6.8	7.1	5.5	81.1	0.8	1.1	1.0	0.3	0.3	0.2	3.7
<b>Sub-Total</b>	<b>108.1</b>	<b>148.1</b>	<b>110.2</b>	<b>84.0</b>	<b>89.3</b>	<b>64.8</b>	<b>604.6</b>	<b>5.4</b>	<b>7.0</b>	<b>4.9</b>	<b>3.6</b>	<b>3.6</b>	<b>2.6</b>	<b>27.0</b>
<b>D. States Remedial Works</b>														
1. Madhya Pradesh	73.8	172.7	227.4	234.0	184.8	166.3	1059.1	3.7	8.1	10.1	9.9	7.5	6.6	45.9
2. Orissa	41.9	74.3	246.4	259.9	275.5	193.2	1091.0	2.1	3.5	11.0	11.0	11.2	7.6	46.4
3. Rajasthan	20.0	46.5	155.6	174.4	183.8	120.5	700.9	1.0	2.2	6.9	7.4	7.5	4.8	29.8
4. Tamil Nadu	31.8	74.2	122.4	126.8	121.5	103.4	580.1	1.6	3.5	5.5	5.4	4.9	4.1	24.9
<b>Sub-Total</b>	<b>167.5</b>	<b>367.6</b>	<b>751.8</b>	<b>795.2</b>	<b>765.6</b>	<b>583.4</b>	<b>3431.1</b>	<b>8.3</b>	<b>17.3</b>	<b>33.5</b>	<b>33.8</b>	<b>31.2</b>	<b>23.0</b>	<b>147.1</b>
<b>Total PROJECTS COSTS</b>	<b>325.8</b>	<b>598.1</b>	<b>963.6</b>	<b>972.2</b>	<b>984.7</b>	<b>735.4</b>	<b>4559.9</b>	<b>16.2</b>	<b>28.1</b>	<b>43.0</b>	<b>41.3</b>	<b>39.3</b>	<b>29.0</b>	<b>198.8</b>

- 95

Values Scaled by 1000000.0 4/18/1991 9:31

**India  
Dam Safety Project  
RS. M**

**Project Components by Year**

	Base Costs						Total	
	91/92	92/93	93/94	94/95	95/96	96/97	RS.M	US\$M
<b>A. GOI/CWC Activities</b>								
1. Institutional Strengthen.	11.2	11.8	10.5	7.5	7.1	6.0	54.2	3.0
2. Flood Forecasting Systems	11.0	22.0	29.9	32.9	39.0	26.2	161.0	8.9
<b>Sub-total</b>	<b>22.2</b>	<b>33.8</b>	<b>40.4</b>	<b>40.4</b>	<b>46.1</b>	<b>32.2</b>	<b>215.2</b>	<b>12.0</b>
<b>B. States Instit. Strength.</b>								
1. Madhya Pradesh	5.9	8.9	10.6	7.6	7.6	6.0	46.6	2.6
2. Orissa	5.4	7.5	8.7	5.7	5.7	4.9	38.1	2.1
3. Rajasthan	5.5	8.3	9.2	6.1	6.1	5.6	40.9	2.3
4. Tamil Nadu	4.7	7.3	7.3	5.3	5.3	4.8	34.8	1.9
<b>Sub-total</b>	<b>21.6</b>	<b>32.1</b>	<b>35.9</b>	<b>24.8</b>	<b>24.8</b>	<b>21.3</b>	<b>160.4</b>	<b>8.9</b>
<b>C. States Basic Safety Fac.</b>								
1. Madhya Pradesh	36.3	36.3	34.5	32.8	32.8	22.6	195.3	10.6
2. Orissa	27.3	27.3	12.4	12.3	12.3	8.3	99.9	5.5
3. Rajasthan	12.3	32.5	17.4	7.6	7.5	5.2	82.5	4.6
4. Tamil Nadu	14.2	18.0	15.6	4.9	4.8	3.5	60.9	3.4
<b>Sub-total</b>	<b>90.1</b>	<b>114.1</b>	<b>79.9</b>	<b>57.6</b>	<b>57.4</b>	<b>39.6</b>	<b>438.6</b>	<b>24.4</b>
<b>D. States Remedial Works</b>								
1. Madhya Pradesh	59.6	129.9	160.2	154.6	114.7	97.2	716.1	39.8
2. Orissa	33.9	55.9	173.6	171.7	171.0	112.9	719.0	39.9
3. Rajasthan	16.3	35.1	109.9	115.3	114.1	70.4	461.1	25.6
4. Tamil Nadu	25.7	55.8	86.3	83.8	75.5	60.4	387.6	21.5
<b>Sub-total</b>	<b>135.5</b>	<b>276.7</b>	<b>530.0</b>	<b>525.4</b>	<b>475.3</b>	<b>340.9</b>	<b>2283.9</b>	<b>126.9</b>
<b>Total BASELINE COSTS</b>	<b>269.4</b>	<b>456.7</b>	<b>688.2</b>	<b>648.1</b>	<b>603.5</b>	<b>434.1</b>	<b>3098.0</b>	<b>172.1</b>
Physical Contingencies	39.3	71.3	113.9	109.3	100.6	71.4	605.8	28.1
Price Contingencies	17.0	70.1	163.5	214.9	260.6	230.0	956.1	-3.4
<b>Total PROJECT COSTS</b>	<b>325.8</b>	<b>598.1</b>	<b>963.6</b>	<b>972.2</b>	<b>964.7</b>	<b>735.4</b>	<b>4559.9</b>	<b>196.8</b>
Taxes	11.0	18.6	27.0	33.5	41.3	31.7	163.1	7.0
Foreign Exchange	56.0	100.9	126.5	114.7	121.0	88.5	607.5	26.4

Values Scaled by 1000000.0 4/18/1991 9:31

**India  
Dam Safety Project  
RS. M**

**Summary Accounts by Year**

	Base Costs							Foreign Exchange	
	91/92	92/93	93/94	94/95	95/96	96/97	Total	%	Amount
<b>I. INVESTMENT COSTS</b>									
A. Civil Works	155.2	292.8	496.9	488.7	445.7	316.8	2196.1	8.0	175.7
B. Equipment	44.2	71.1	56.6	39.7	46.0	28.6	286.2	56.2	160.8
C. Land Acquisition	1.3	1.3	0.8	0.0	0.0	0.0	3.4	0.0	0.0
D. Training, TA, Consultants	20.2	21.4	24.8	12.5	10.9	10.7	100.5	20.0	20.1
E. Design, Supervis.& Admin.	17.3	34.6	63.5	63.5	57.3	41.3	277.5	4.8	13.2
<b>Total INVESTMENT COSTS</b>	<b>238.2</b>	<b>421.2</b>	<b>642.6</b>	<b>604.4</b>	<b>559.9</b>	<b>397.4</b>	<b>2863.7</b>	<b>12.9</b>	<b>369.8</b>
<b>II. RECURRENT COSTS</b>									
F. Incremental Staff	13.2	17.2	23.1	23.1	23.1	19.2	118.9	0.0	0.0
G. Incremental Oper. Exp.	18.0	18.3	20.5	20.5	20.5	17.4	115.4	5.0	5.8
<b>Total RECURRENT COSTS</b>	<b>31.2</b>	<b>35.5</b>	<b>43.6</b>	<b>43.6</b>	<b>43.6</b>	<b>36.6</b>	<b>234.3</b>	<b>2.5</b>	<b>5.8</b>
<b>Total BASELINE COSTS</b>	<b>269.4</b>	<b>456.7</b>	<b>686.2</b>	<b>648.1</b>	<b>603.5</b>	<b>434.1</b>	<b>3098.0</b>	<b>12.1</b>	<b>375.6</b>
Physical Contingencies	39.3	71.3	113.9	109.3	100.6	71.4	505.8	10.8	54.6
Price Contingencies	17.0	70.1	163.5	214.9	260.6	230.0	956.1	18.5	177.3
<b>Total PROJECT COSTS</b>	<b>325.8</b>	<b>598.1</b>	<b>963.6</b>	<b>972.2</b>	<b>964.7</b>	<b>735.4</b>	<b>4559.9</b>	<b>13.3</b>	<b>607.5</b>
Taxes	11.0	18.6	27.0	33.5	41.3	31.7	163.1	0.0	0.0
Foreign Exchange	56.0	100.9	126.5	114.7	121.0	88.5	607.5	100.0	607.5

Values Scaled by 1000000.0 4/18/1991 9:31

**India  
Dam Safety Project  
Financing Plan by Disbursement Category  
US\$ M**

	IDA/IBRD		Government of India		Total		For. Exch.	Local (Excl. Taxes)	Duties & Tax.
	Amount	%	Amount	%	Amount	%			
A. Civil Works	128.8	90.0	14.3	10.0	142.9	72.6	13.1	127.0	2.9
B. Land	0.0	0.0	0.2	100.0	0.2	0.1	0.0	0.2	0.0
C. Equipment	13.7	73.5	4.9	28.5	18.6	9.5	10.8	3.8	4.1
D. Con., TA, Training	6.0	100.0	0.0	0.0	6.0	3.1	1.3	4.7	0.0
E. Design & Supervision	0.0	0.0	16.5	100.0	16.5	8.4	0.9	15.6	0.0
F. Incremental Staff	4.7	73.2	1.7	26.8	6.4	3.2	0.0	6.4	0.0
G. Incre. Operating Costs	0.0	0.0	6.2	100.0	6.2	3.2	0.4	5.9	0.0
<b>Total Disbursement</b>	<b>153.0</b>	<b>77.7</b>	<b>43.8</b>	<b>22.3</b>	<b>196.8</b>	<b>100.0</b>	<b>26.4</b>	<b>163.4</b>	<b>7.0</b>

Values Scaled by 1000000.0 4/18/1991 9:31

**INDIA**  
**DAM SAFETY PROJECT**  
**SCHEDULE OF DISBURSEMENTS**

<u>Bank/IDA Fiscal Year and Semester</u>	<u>Bi-Annual</u>	<u>Cumulative</u>	<u>% of Loan Credit</u>
	US\$ millions		
1992			
First	8.0	8.0	5
Second	7.6	15.6	10
1993			
First	7.7	23.3	15
Second	9.2	32.5	21
1994			
First	10.7	43.2	28
Second	12.2	55.4	36
1995			
First	16.9	72.3	47
Second	18.3	90.6	59
1996			
First	18.4	109.0	71
Second	15.3	124.3	81
1997			
First	15.3	139.6	91
Second	10.8	150.4	98
1998			
First	2.6	153.0	100





INDIA

DAM SAFETY PROJECT

BANK SUPERVISION INPUT INTO KEY ACTIVITIES

<u>Approximate Dates</u>	<u>Activity</u>	<u>Expected Skill Requirements</u>	<u>Staff Input (staffweeks)</u>
6/91	Coordinate LCB contract review.	Procurement & Task Manager.	1.0
8/91	Complete evaluation of LCB procedures.	R. M. Procurement.	1.2
9/91	<u>Project Launch Workshop</u> Review Implementation Sched. Workshop with chairman DSRP, clear procurement procedures, assure reporting system established, review staffing status, initiate library acquisitioning, start selection of consultants on gate simulations.	Task Manager, International Dam Safety Consultant, MIS/Project Management State Government Consultant, Procurement Specialist.	8.0
1/92	<u>Supervision Mission</u> Review of remedial design & DSRP activities in each state TOR's on consultancies DSO program & inspection schedules, DSC procedures.	Task Manager, Project Management Specialist, State Government Consultant.	6.0
5/92	<u>Supervision Mission</u> Review initial contracting and active construction, attend 2-3 DSRP meetings field visits of active inspection teams, upgrade project reporting, review DSC prioritization examine IMD progress with CWC and Flood Operations Simulation Software.	Task Manager, Dam Engineer State Consultant, MIS/Project Management, Procurement Specialist.	7.0

---

Approximate Dates	Activity	Expected Skill Requirements	Staff Input (staff weeks)
10/92	<u>Supervision Mission</u> Evaluation construction program, quality control, procurement, review flood forecasting evaluations, state staffing progress, training programs	Task Manager, State Consultant, Training Specialist, Construction Engineer.	8.0
5/93 9/93	<u>Supervision Mission</u> Normal progress	Task Manager, State Consultant, Specialists as required.	8.0
2/94	<u>Mid-Term Review</u>	Task Mngr., State Consultant, International Dam Safety Consultant, MIS/Project Management, Procurement/ Disbursements	11.0
8/94	Supervision Thereafter	Twice per year.	