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Report No: 20399

IMPLEMENTATION COMPLETION REPORT
(Intensive Learning Model (ILM) of ICR)

ON A

CREDIT

IN THE AMOUNT OF SDR 96.2 MILLION

AND ON A

LOAN

IN THE AMOUNT OF US\$23 MILLION

TO THE

GOVERNMENT OF INDIA

FOR A

DAM SAFETY PROJECT

PROJECT ID: P009877

IBRD LOAN NUMBER: 3325-IN

IDA CREDIT NUMBER: 2241-IN

May 10, 2000

**Rural Development Sector Management Unit
South Asia Region**

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CURRENCY EQUIVALENTS

Currency Unit = Rupees (Rs.)

1991: US\$ 1.00 = Rs. 18.58

1992: US\$ 1.00 = Rs. 25.95

1993: US\$ 1.00 = Rs. 26.20

1994: US\$ 1.00 = Rs. 31.37

1995: US\$ 1.00 = Rs. 31.38

1996: US\$ 1.00 = Rs. 35.67

1997: US\$ 1.00 = Rs. 35.87

1998: US\$ 1.00 = Rs. 39.37

1999: US\$ 1.00 = Rs. 42.50

FISCAL YEAR

April 1 – March 31

WEIGHTS AND MEASURES

1 meter (m) = 3.28 feet; 1 kilometer (km) = 0.62 miles; 1 hectare (ha) = 2.47 acres ;

1 million cubic meter (Mm³) = 810 acre-feet or 35.3 Mft³

1 cubic meter per second (m³/s) = 35.31 cubic foot per second (cfs);

1 cubic foot per second (cfs) = 0.028 cubic meters per second (m³/sec); 1 metric ton = 2,205 pounds

ABBREVIATIONS AND ACRONYMS

Category I dams	Dams identified at appraisal for remedial works
Category II dams	Dams that at appraisal required to be inspected and investigated for identifying required remedial works
CWC	Central Water Commission
DAD	Depth Area Duration
DCA	Development Credit Agreement
DOI	Department of Irrigation (Rajasthan)
DSC	Dam Safety Committee (in each Project State)
DSO	Dam Safety Organization (in CWC and in each Project State)
DSRP	Dam Safety Review Panel
DOWR	Department of Water Resources (Madhya, Pradesh, Orissa and Tamil Nadu)
ERR	Economic Rate of Return
FRR	Financial Rate of Return
FRL	Full Reservoir Level
GOI	Government of India
GOR	Government of Rajasthan
GOTN	Government of Tamil Nadu
HO	Hydrology Organization of CWC
ICOLD	International Committee on Large Dams
IITM	India Institute for Tropical Meteorology
ICR	Implementation Completion Reporting
IMD	India Meteorological Department
ILI	Intensive Learning ICR
MOF	Ministry of Finance
MTR	Midterm Review
MWL	Maximum Water Level
O&M	Operation and Maintenance
PCR	Project Completion Report
PMF	Probable Maximum Precipitation
SAR	Staff Appraisal Report
SDSO	State Dam Safety Organization
SPF	Standard Project Flood

Vice President: Mieko Nishmizu

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IMPLEMENTATION COMPLETION REPORT
INDIA

DAM SAFETY PROJECT
(Loan No. 3325-IN / Credit No. 2241-IN)

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IMPLEMENTATION COMPLETION REPORT

INDIA

DAM SAFETY PROJECT

(Loan No. 3325-IN / Credit No. 2241-IN)

Preface

This is the Intensive Learning Implementation Completion Report (ILI) for the Dam Safety Project in India, for which Loan 3325-IN in the amount of US\$23 million and Credit 2241-IN in the amount of SDR 96.2 million (US\$130 million equivalent) were approved on May 14, 1991 and made effective on July 11, 1991. The participating states were Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu. The Loan was canceled on June 11, 1995. SDR 20 million (US\$27.2 million) was canceled from the Credit on July 31, 1997 and a further SDR 7.4 million (US\$10.1 million) was cancelled on September 30, 1998.

The Credit closed on September 30, 1999, two years later than planned at appraisal. Final disbursement took place on February 28, 2000 at which time a balance of US\$ 9.017 million was cancelled.

The ICR was prepared jointly by the staff of SASRD and FAO/World Bank Co-operative Program and reviewed by Mr. Christopher Konecki (EASRD) and Dr. Subhash Chandra (Consultant). The Borrower provided comments that are a supporting document in the ICR file.

Preparation of this ILI was begun during a mission to India between October 19 and November 14, 1999, during which all participating states were visited. This included site visits and detailed discussions with officials and stakeholders, the holding of a Stakeholders Workshop in New Delhi on November 11-12, 1999, conducting a Beneficiary Survey in October-November 1999 and examination of material in the project file. The ILI mission included participation of the World Bank's Dam Safety Advisor, Mr. Alessandro Palmieri. The results of the Beneficiary Survey and the Stakeholders' Workshop are presented respectively in Annexes 8 and 9. The Borrower contributed to the preparation of the ICR by providing draft Project Completion Reports prepared by each of the participating states and the Central Water Commission.

<i>Project ID:</i> P009877	<i>Project Name:</i> DAM SAFETY
<i>Team Leader:</i> E. V. Jagannathan	<i>TL Unit:</i> SASRD
<i>ICR Type:</i> Intensive Learning Model (ILM) of ICR	<i>Report Date:</i> May 10, 2000

1. Project Data

Name: DAM SAFETY *L/C/TF Number:* 33250; 22410
Country/Department: INDIA *Region:* South Asia Regional Office
Sector/subsector: VM - Natural Resources Management

KEY DATES

	<i>Original</i>	<i>Revised/Actual</i>
<i>PCD:</i> 12/08/89	<i>Effective:</i> 09/09/91	07/11/91
<i>Appraisal:</i> 12/01/90	<i>MTR:</i> 03/31/94	12/01/94
<i>Approval:</i> 05/14/91	<i>Closing:</i> 09/30/97	09/30/99

Borrower/Implementing Agency: Government of India/CENTRAL WATER COMMISSION
Other Partners: Governments of Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu

STAFF	Current	At Appraisal
<i>Vice President:</i>	Mieko Nishimizu	A. Karaosmanoglu
<i>Country Manager:</i>	Edwin Lim	Heinz Vergin
<i>Sector Manager:</i>	Ridwan Ali	J. Alejandro GutierrezWijnand
<i>Team Leader at ICR:</i>	E.V. Jagannathan	W. Price
<i>ICR Primary Author:</i>	E.V.Jagannathan; and R.G. Paterson (FAO-CP)	

2. Principal Performance Ratings

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HL=Highly Likely, L=Likely, UN=Unlikely, HUN=Highly Unlikely, HU=Highly Unsatisfactory, H=High, SU=Substantial, M=Modest, N=Negligible)

Outcome: S
Sustainability: L
Institutional Development Impact: SU
Bank Performance: S
Borrower Performance: S

Quality at Entry: QAG (if available) ICR
U
Project at Risk at Any Time:

3. Assessment of Development Objective and Design, and of Quality at Entry

3.1 Original Objective:

3.1.1 The objectives of the project as described in the Development Credit Agreement (DCA) were to improve the safety of selected dams in the Project States through (a) remedial works, (b) installation of basic safety facilities, and (c) strengthening of the institutions of the Borrower and the project states responsible for assuring dam safety.

3.1.2 These objectives were realistic and important for the country, which had many dams that required safety review and strengthening. When the project was prepared, the Government of India (GOI) was seeking to become more effective in dam safety assurance. Although a start had been made in laying out a conceptual framework and establishing a National Committee on Dam Safety and a starting nucleus of a Dam Safety Organization (DSO) in the Central Water Commission (CWC), the tempo of dam safety activity in India had not kept pace with the needs, and a backlog of potential risk had accumulated. It was realized that many large dams were hydrologically unsafe in that they had experienced floods larger than their original design floods. There was a lack of funding, insufficient institutions specialized in dam safety and a shortage of technically specialized staff allocated exclusively to the needs of maintaining an active, viable dam safety assurance program. The project was to address these issues. The project was unique in that it was the first Bank project directed entirely at dam safety. The standards followed under this project were essentially those set out by the International Commission on Large Dams (ICOLD), which are generally accepted as applicable in many countries.

1. Large dams are defined as being more than 15 m high or more than 10 m high and either more than 500 m long or with reservoir volume more than 1 Mm³ or maximum flood discharge greater than 2,000 m³/s.

3.2 Revised Objective:

None

3.3 Original Components:

3.3.1 The original components were:

- (a) Institutional strengthening of CWCs, DSOs, and CWCs, Hydrology Organization (HO) through assignment of staff, training, technical assistance, provision of equipment and consultant support (\$3 million).
- (b) Reviewing the existing flood forecasting facilities in one or more selected interstate river basins and exploring the possibility of improving such facilities (\$10.7 million).
- (c) Technical assistance to Dam Safety Committees (DSC) to be established in each project state; and institutional strengthening of DSO and the Department of Irrigation (DOI) and Department of Water Resources (DOWR) through additional staff, technical assistance, training, provision of equipment, and services of consultants (\$9 million).
- (d) Improvement of basic safety related facilities at an unspecified number of dam sites selected by the project states through provision of communications equipment and real time hydrologic data gathering equipment, power backup systems, monitoring instrumentation, construction and rehabilitation of all-weather access roads, and other means (\$27 million).
- (e) Remedial works at dams selected in accordance with criteria established by DSC (\$147.1 million).

3.3.2. These components were well suited to achieving the stated objectives of the project and, subject to the issues described below, were suited to the capacities of the implementing agencies.

3.4 Revised Components:

3.4.1 The project was restructured twice. The restructuring was mainly in the remedial works component which constituted 75 percent of project costs. In September 1997, the Annex to Schedule 2 of the DCA was amended to reflect actual progress and what could realistically be expected during the extended project period by omitting seven dams (out of 33) identified for remedial works (Category I dams) and listing 14 dams to be inspected and investigated to identify required remedial works (Category II dams). A condition for further extension was that satisfactory progress should be made during the period of the first extension.

3.4.2 In September 1998, when the closing date was extended, the extension did not include Tamil Nadu because of its unsatisfactory performance. This eliminated a further 5 dams and reduced the total number of Category I dams under remedial works to 21 (there were no Category II dams in Tamil Nadu). Also, telemetry for Hirakud Dam in Orissa did not figure in the extension from the basic facilities component of the project due to difficulty in resolving contractual problems.

3.5 Quality at Entry:

3.5.1 The project was unique, being the first World Bank project devoted entirely to dam safety. Though the components were relatively straight forward the project was institutionally complex, involving four states and central government in all stages of inspection, investigation, design, approval, procurement and implementation of works that were often technically sophisticated and outside the normal experience of many of those involved. The development of institutional arrangements, building on the idea of DSO that would be responsible for reviewing and inspecting large dams and identifying those requiring urgent remedial works, was both right and necessary. The project correctly included important and valuable subordinate activities such as the development of atlases of probable maximum precipitation (PMP), the further development of flood forecasting and the need for operational models for emergency spillway operation. The risk that states would be slow in making funds available for remedial works was correctly identified at appraisal.

3.5.2 However, appraisal of the project had a number of deficiencies. Project preparation in the states was not as far advanced as assumed in the Staff Appraisal Report (SAR) and did not comply with the general rule of OMS 2.28¹ that procurement for the first year's program should be able to start shortly after loan approval. The project also did not address chronic problems already recognized in Bank-financed irrigation projects concerning delays in procurement, timeliness and adequacy of counterpart funds, and continuity of staff in state implementing agencies. The lack of constitutional authority and legislation for CWC to enforce a national program of dam safety assurance was recognized as a problem (SAR Annex 1, para 19), but the project did not address it. No attempt was made to estimate the benefits of the project works, and there was no justification at all given for the inclusion of the flood forecasting component. Criteria for judging achievement of project objectives were not well quantified in the SAR. Although the number of dams identified at appraisal for remedial works (Category I dams) was clearly stated, there was no target for remedial works on dams yet to be identified (Category II dams), nor for most basic facilities.

3.5.3 Technical weaknesses in the project design included: (a) an over emphasis on the design flood as the determinant of safety with less regard to the general flood regime and the general flood operation of dams; (b) lack of appreciation of the importance of historical data, particularly the characteristics of historical floods; and (c) unclear lines of responsibility and leadership for the project, especially to deal with problems on interstate rivers (see Annex 7.2). In other words, structural issues (such as adequate

spillway capacity) were stressed, perhaps at the expense of nonstructural issues (spillway operation, flood mitigation). The linkage between flood forecasting and the operation of the dams during floods is not well developed, and the SAR did not define well enough a program of work to ensure the linkage of these issues. The hydrological tasks were not specified in sufficient detail nor were they comprehensively defined in the SAR. There should at least have been a requirement to study in detail the highest flood of record at each dam, including analysis of the reservoir operation used to pass it, and to seek lessons from alternative operation strategies using computer simulation.

3.5.4 Given the project's uniqueness, it was to be expected that problems would be encountered and lessons learned at all stages from design through implementation. Such was indeed the case, and it is appropriate to recognize this as the wisdom of hindsight is applied to all phases of this operation. Nevertheless, the lack of readiness for implementation at the start of the project (in institutional capacity, hydrological design and procurement) could have been better appreciated at appraisal. This lack of readiness had a direct bearing on the initial performance of the project; as discussed below. It took several years for the program to gather momentum, and the core implementation difficulties of the project are mostly attributable to this starting situation. Accordingly, quality at entry is rated **unsatisfactory**. For both the Bank and the borrower, preparedness could have been better. Alternatively, the project could have been down scaled or might have included a two- to three-year initial phase for building institutional capacity and technical readiness.

1. The World Bank Operational Manual Statement 2.28. State of project preparation necessary for loan approval.

4. Achievement of Objective and Outputs

4.1 Outcome/achievement of objective:

4.1.1 Notwithstanding the start-up difficulties that the project had to overcome, and a number of implementation difficulties discussed in this and subsequent sections, the overall outcome of the project was positive. This conclusion is supported by the perception of the stakeholders (of respondents to the Intensive Learning ICR (ILI) beneficiary survey, 88 percent considered the project had fully or partially achieved its objectives; see Annex 8). The project outcome is thus rated as **satisfactory**.

4.1.2 The "institutionalization" of dam safety. A key achievement is that dam safety has become generally accepted in India as a necessity, with an important start also made in terms of development of institutions and technical capacity. At central and state levels, awareness has grown appreciably. The initially fledgling central institutions have been strengthened considerably. At the level of the four states, institutions (previously nonexistent in some states) and basic capacity for dam safety have been created. The start made by these states and through promotion of dam safety by the center has started to spill over to other states. Thus 12 states (out of 25 states) owning about 4,251 large dams are members of the National Committee on Dam Safety, play active roles. Considerable interest has also been expressed in a follow-on dam safety project, with all 12 states requesting participation. In the ILI Beneficiary Survey, two-thirds of the respondents felt that the Dam Safety Project was "highly relevant", and two-fifths felt that expenditure on dam safety should be the first charge on water sector investment in India.

4.1.3 As discussed in section 4.2.2 it appears that commitment by the Government of Madhya Pradesh (GOMP), the Government of Rajasthan (GOR) and the Government of Orissa (GOO) to the institutional concept, as envisaged in the project documents, continues. The concept of prioritization of dams and rehabilitation measures has been adopted. The institutional strengthening in terms of creation and

operation of permanent DSOs equipped with requisite staff carrying out periodic inspection of the health status of large dams has been achieved. CWC has also been strengthened, with permanent staff increased and equipment and training provided. In other words India's "dam safety assurance program" has made an important start towards being "institutionalized".

4.1.4 An exception to this positive institutional progress has been the of Government Tamil Nadu (GOTN). Its commitment to the institutional concept has waned. GOTN has now severely reduced the number of staff in the DSO, so that, at the time of the Implementation Completion Report (ICR) mission, only four technical staff remained. Continuation of this situation would seriously affect the DSO's future operation, although GOTN has informed the ICR mission that staff numbers would be increased again.

4.1.5 Improvement in physical safety. The objective of improving dam safety in the four project states through carrying out remedial measures has been achieved at 33 sick dams. Although about half of the 33 dams at which remedial works are completed differ from the initially identified list of 33 dams in the SAR, dam safety works were adequately identified and implemented. Additionally, works are ongoing at seven other sites. In terms of value of construction, the remedial works achieved of Rs 2,806 million amount to 82 percent of the appraisal estimated Rs 3,431 million. Based on selective examination of documents, discussion with state and national experts and site visits, reduction of seepage through dams, structural improvements and increased spillway capacities for increased design floods dams have improved dam safety.

4.1.6 Under the basic safety facilities component, more works than originally intended have been completed. Some Rs 788 million of works have been completed against Rs 604 million estimated at appraisal. These incremental facilities enhance basic requirements for safety assurance and have also added to the safety of the dams.

4.1.7 Shortcomings and improvement areas. Most of the training provided by the project was conducted later than envisaged in the SAR, which contributed to delay in implementation of the project. In a number of cases the dam safety concept and new knowledge obtained from training courses have not trickled down to operative level at dams. The concept of prioritization of dams and rehabilitation measures has sometimes been adopted with little care to an objective and technically sound assessment of risk. In some cases, dam serviceability has been addressed rather than safety.

4.1.8 For interstate rivers there is a need to assign responsibility for resolving issues on dams and cascades of dams. While CWC accepts its role as having responsibility for safety issues relating to downstream areas as a result of projects on interstate rivers, it is not playing a proactive role mainly due to the advisory role it is called upon to play on projects/dams constructed on inter-state rivers. CWC has the ability to compute design floods, and has the software capability to examine the problem holistically. Present institutional inertia illustrates the need for clearer guidelines on responsibilities, and the need to develop or improve river basin authorities or boards which could expedite and guide the actions needed (see Annex 7.4).

4.1.9 During the ICR field visits, it became clear that operation rules for many reservoirs are inadequate. The general nature of the rules does not permit simple direct gate operations in a flood emergency. Nor are the management arrangements such as to ensure rapid response to floods (see Annex 7.3). There is a need to define procedures/decision support system for reservoir gate operation during floods to ensure more effective control of flood attenuation to optimize downstream benefits and to deliver benefits from flood forecasting. These procedures will depend on the availability of forecasts and other information. Guidelines to operate the gates in case of non-availability of information be formulated and prominently

displayed in the gate operating rooms at dams.

4.1.10 States generally do not have adequate hydrological capability to estimate design floods and review flood operating strategies¹. They prefer to rely on CWC or consultants. However, consultants entrusted with probable maximum flood (PMF) analysis have not always performed well. This appears to be due in part to lack of precise terms of reference and adequate supervision. Engineers in India are encouraged to be generalists, and hydrologists are seen as largely within the engineering .

1. Although the objectives of the Hydrology Project (Cr. 2774-IN) are to improve arrangements, capabilities and facilitates for measurement, validation, collation, analysis, transfer and dissemination of hydrological and hydrometeorological data, attention is not paid in that project to estimating design floods.

profession. As disciplines such as hydrology become increasingly technical, this generalization is becoming outdated.

4.1.11 Sensors and telemetry for the intended flood forecasting systems have been installed and are operating but the objective of this component has not yet been achieved in that the system has not yet produced any flood forecasts. The calibration/operation phase is expected in the monsoon period of 2000. However it is not clear how the expected output will be incorporated into reservoir operations. The flood forecasting component would have been improved had it included the determination and evaluation of reservoir operating strategy during floods and the impact of this strategy on dam safety. This should also be linked to economic analysis of costs and benefits of alternative operating rules. The lack of quantification of potential benefits (such as the reduction of damages and losses downstream of the dam) has resulted in the importance of dam safety not being fully appreciated by those who prioritize the allocation of funds.

4.2 Outputs by components:

4.2.1 Institutional strengthening of CWC's DSO, and HO. The CWC's DSO, and HO have been strengthened in terms of dam safety and hydrological review capability and this strengthening is both effective and sustainable. The present deployment of staff in CWC's DSO and HO is 117 compared to 103 targeted under the project. Regional precipitation atlases have been prepared for two regions against a projection of three at the SAR stage. The balance work on the preparation of atlases has been initiated but not completed. The training of the required staff, technical assistance and equipment have generally been completed as planned (see Annex 1) and CWC is now capable of ensuring that design floods are correctly computed and that procedures for inspection, investigation, identification, selection, prioritization, and preparation of plans of action are properly executed not only for project dams but also for other dams in India. Draft guidelines on risk analysis have been drafted with the help of the consultants and proposed for discussion in the National Committee on Dam Safety before their finalization and adoption. CWC reviewed the flood forecasting facilities in the Chambal and Mahanadi Basins and improvements are being implemented. Technical assistance was provided to each state DSC. CWC along with the participating states also carried out hydrologic review of 128 dams (appraisal estimate 170) and gave procedural clearance for structural review/carried out structural review of 49 dams (appraisal estimate 44). It is to be hoped that CWC will extend and focus its remit, especially in terms of being proactive in resolving issues relating to dams or cascades of dams on interstate rivers.

4.2.2 **Institutional strengthening of DSO and DOI/DOWR in the project states** has been substantially achieved. The staffing status is as shown below:

State	Projected at appraisal	Staff in place at ICR
Madhya Pradesh	101	82
Orissa	76	68
Rajasthan	80	77
Tamil Nadu	55	12
Total	312	239

The staffing position is generally satisfactory in the DSOs except in Tamil Nadu. While the staff in place at the time of the ICR is 82 (compared to 101 targeted at appraisal), in Madhya Pradesh most staff classed as incremental in the SAR have been redeployed from within their organization. In addition to the measures described in the SAR, good initiatives have been taken by some states to prepare history of dams records describing the design and past performance of many of their dams. In Rajasthan, DSO publishes a regular newsletter with articles related to dams. The states have also performed satisfactorily in carrying out Phase I inspections of 1,510 dams (appraisal estimate 947) and Phase II investigations of 81 dams (appraisal estimate 147), in addition to pre/post-monsoon inspection carried out for a number of dams. These inspections have been institutionalized in all the project states, including Tamil Nadu.

4.2.3 There is a need for more specialization and the development of experience in specific fields. Flood analysis, flood forecasting, reservoir operation, and the other aspects of the hydrology of reservoirs is one such field where specialization is desirable. The frequent transfer of engineers who have received specific training is counter-productive.

4.2.4 **Basic safety facilities** have been provided at dams in all project states, substantially enhancing their safety. Achievements in financial terms were Rs 788 million or 130 [percent of the appraisal estimate of Rs 604 million (there were no physical targets specified at appraisal). A substantial number of dams were provided with basic facilities as shown below:

Facility	No. of dams actually provided with
Access Road	181
Communication System	148
Back-up power system	103
Hydrological instrumentation	172

4.2.5 Over 90 percent of the respondents to the beneficiary survey considered the quality of the basic facilities satisfactory. In all 182 dams were provided with basic safety facilities. However basic safety facilities have not been adequately included in dam safety plans (operation and maintenance (O&M) procedures and emergency preparedness plans). The supply of instruments and monitoring devices was less than SAR expectations.

4.2.6 **Remedial works** at 17 out of 33 Category I dams identified at appraisal have been completed, nine other Category I dams have been partially completed, while remedial works at 16 Category II dams (i.e., not specifically named in the SAR), have been completed. The remedial works amounted to Rs 2,795 million, or 81 percent of the appraisal estimate of Rs 3,431 million.

4.2.7 In summary, the number of dams at which basic facilities have been provided and where remedial works have been done are shown below.

State	Basic Facilities Complete	Remedial Works			
		SAR a/ (Cat I)	Completed (Cat I)	Partially completed (Cat I)	New completed (Cat. II)
Madhya Pradesh	91	8	3	5	10
Orissa	15	9	6	3	2
Rajasthan	60	7	5	2	2
Tamil Nadu	16	9	3	6	2
Total	182	33	17	16	16

a/ Category. I dams are those dams which are specifically named in SAR/DCA for undertaking remedial works. Category II dams have not been specifically named in SAR to receive remedial works.

4.2.8 Notwithstanding these generally satisfactory physical achievements, reservoir operations need improvement in several respects. During the ICR field visits it became clear that operation rules for many reservoirs are inadequate. The general nature of the rules does not permit simple direct gate operations in a flood emergency and the management arrangements are not such as to ensure rapid response to floods. There is insufficient awareness of the valuable role that flood forecasting can play in improving operation and in providing greater benefits. There is need for much improvement in the operation of dams with gated spillways. Properly thought out operating instructions are needed and the procedures for operating gates at times of flood must be clearly defined and displayed prominently at the dam (see Annex 7.3).

4.3 Net Present Value/Economic rate of return:

4.3.1 At appraisal, conventional cost/benefit analysis was considered not to be an appropriate measure or criterion for evaluation of this project. The SAR justified the project 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. While economic analysis is an important factor among many other factors (potential risks of failure, social impact, etc.), there is still much work to be done in devising a suitable and comprehensive set of criteria for prioritization, which would include not only parameters (such as dam

height and reservoir volume) but would also take into account the extent of potential loss of life and physical damage downstream. It may be too much to expect that at the time of appraisal such analysis could have been undertaken; for this reason the ICR has not tried to estimate the economic rate of return (ERR) or the FRR.

4.4 Financial rate of return:

Not applicable.

4.5 Institutional development impact:

4.5.1 As discussed in sections 4.1 and 4.2, the project has substantially strengthened the institutional base for dam safety in the central government and the participating states. At state levels, this required in some cases establishing (Rajasthan, Tamil Nadu) and subsequent developing and strengthening (in all states) of institutions (the DSOs, state DSCs and the Dam Safety Review Panels (OMS 3.8/OP 4.37). These institutions existed at the central government level and have been strengthened considerably under the project. Notwithstanding the various recommendations for improvements discussed in this report, these institutions have been largely effective in implementing the dam safety assurance programs. The first five-year cycle of safety inspection of large dams has been satisfactorily completed in all four states (inspection of 1,455 dams against the SAR estimate of 947 dams). The second inspection cycle has already started for about 100 dams. Biannual inspections of all dams continue. CWC has effectively contributed to this by training, issuing guidelines for the dam safety program, carrying out dam break analyses, reviewing hydrology, preparing PMP atlases for hydrology studies, developing design flood computation procedures, preparing computer simulation models for training in operation of gated spillways, and preparing guidelines for emergency preparation procedures. Guidelines for risk analysis and hazard classifications have been drafted but not yet finalized. Based on these achievements, the permanent staff strength established, ongoing and planned work programs, and the commitment expressed during the Stakeholders' Workshop (Annex 9), the dam safety assurance program is likely to be continued on a permanent basis after the project. This assessment is also reflected in the Beneficiary Survey (Annex 8), where only 9 percent of the respondents felt that the DSOs would revert back to pre-project status after the project. Tamil Nadu is the worrisome exception—unless the DSO is restored to an adequate working level of qualified staff, Tamil Nadu's dam safety program would be significantly impaired. Based on the analysis and strongly positive assessment for the central institutions and in three of the four states, the institutional development impact of the project is rated **substantial**.

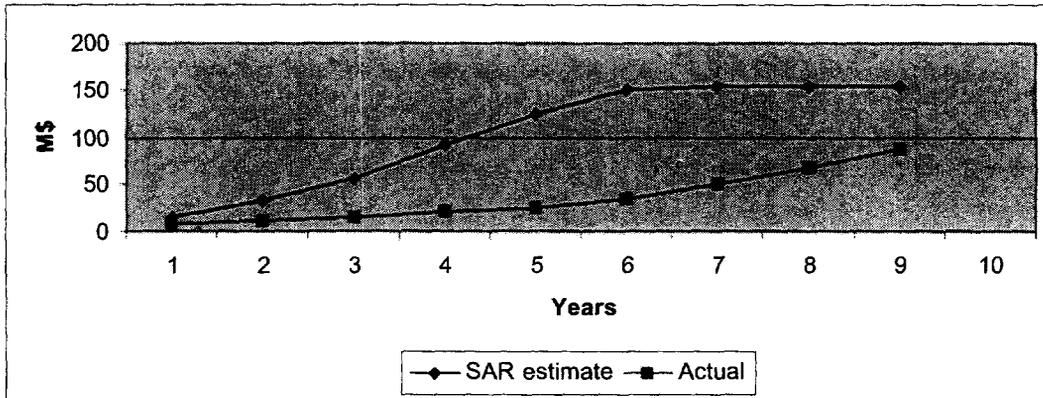
5. Major Factors Affecting Implementation and Outcome

5.1 Factors outside the control of government or implementing agency:

5.1.1. Alterations in the rate of exchange between the Indian Rupee and the dollar substantially augmented the Rupee equivalent of the Bank's assistance. The Rupee depreciated by 10 percent between the appraisal date and approval date; 54 percent between approval date and the midterm review (MTR); 16 percent between MTR and the first extension in September 1997; 17 percent between September 1997 and the second extension in September 1998; and 2 percent between the second extension and the credit closing date. In 1995 this contributed to the cancellation of the \$23 million loan. In 1997 the credit closing date was postponed by one year, the project was restructured and SDR 20 million (\$27.2 million) was canceled from the credit. The project was again extended by a year and restructured in 1998, when Tamil Nadu was dropped from the project and a further SDR 7.4 million (\$10.1 million) was canceled from the credit.

5.2 Factors generally subject to government control:

5.2.1 In spite of the availability of advance IDA funding of up to 25 percent of the approved budget at the start of the fiscal year, the implementing agencies in the states generally did not obtain this advance due to lack of coordination between DEA and the state finance departments. There was often a shortage of funds and this contributed to delays in implementation. The allotment of funds often did not correspond to the approved budget. Delayed cash flow was an important factor in delay of remedial works, especially in the first quarter of each financial year. A contributing factor to the delay of project implementation was a general ban imposed by the MOF on recruiting new staff and the creation of new posts. Disbursement lagged significantly behind the appraisal schedule throughout the project (shown below). Although the two primary reasons were because of the initial state of nonreadiness for physical implementation under the project discussed in section 3.4, and the enhanced value of the loan/credit in Rupee equivalents (in Rupee terms, the project by closure had spent 93 percent of the appraisal estimated project costs), these were further exacerbated by the constraints in finance availability during the working season, and other implementation issues noted elsewhere in this report. The total disbursement is \$85.7 million--about 56 percent of the \$153 million estimated at appraisal.



5.3 Factors generally subject to implementing agency control:

5.3.1 Delay in agreement of parameters for remedial works was the main factor affecting the project. For design floods this was the responsibility of CWC (see DCA paragraph 3.04). Annex 13 of the SAR planned completion of investigation and analysis for all 7 Category A dams by March 1992; 5 Category B dams by September 1992; and 21 Category C dams by June 1993. Annex 4 of the SAR shows hydrological review to be completed for 6 Category A dams, and 3 Category B dams by April 1991. Except for a few large reservoirs like Gandhysagar and Hirakud (for which reviews were completed later), hydrology review was not completed until end-1993 or mid-1994. At the project's outset CWC suffered delays due to tardiness in redeployment of staff to DSO, and only in the extended project period were full staff employed in the designated posts. The opinion was stated at the stakeholders' workshop that there was an overlap in the perceived responsibilities of CWC, consultants, DSRPs, and others.

5.3.2 There were many procurement delays due to cumbersome administrative arrangements and lack of familiarity with Bank procedures, aggravated by frequent changes of staff. At times nonavailability of funds caused the finance departments to delay approval of award of contracts. The failure of Tamil Nadu

to meet performance targets during the first year of the project extension resulted in the state being omitted from the project on October 1, 1998. In 1997 it was reported that contract awards for works to increase spillway capacity were being purposely delayed by DOWR officers in several states, who considered the works unjustified (due to the opinion that revised spillway requirements had been overestimated). There were considerable delays in procurement of instruments and their installation at dams due to difficulties in mobilizing contractors for small works at scattered locations. Frequent rotation of staff required increased training efforts.

5.3.3 Another factor inhibiting project implementation was the performance of CWC in the initial years of the project when CWC saw its coordination role in a less proactive manner and expected the states to make the initial steps. This was apparent in issues related to dam break modeling and preparation of conceptual action plans. In some instances CWC was unable to persuade the states concerning the appropriateness of the revised design floods and the need for risk analysis. There were serious differences between CWC and the state dam safety review panels. There also appears to be an overlap of the roles of CWC as an approving authority and as consultant.

1. Category A Dams: top priority dams with evaluations and designs nearly complete (hydrologic reassessment already made); Category B Dams: deficiencies identified but investigation and evaluation incomplete (hydrologic reassessment not yet made); Category C Dams: partial deficiencies identified, no significant investigations or designs made (hydrologic reassessment not yet made); Category D Dams: Dams yet to be fully inspected and evaluated (hydrologic reassessment most likely required).

5.4 Costs and financing:

5.4.1 Estimates of the actual costs are compared with the estimates in the SAR (given below).

Project Component	Rs. million			\$ million		
	SAR	Actual/ Latest Estimate	Actual SAR %	SAR	Actual/ Latest Estimate	Actual SAR %
Institutional Strengthening (CWC)	68.30	113.43	166	3.00	3.10	103
Flood Forecasting Systems (CWC)	250.10	174.39	70	10.70	4.29	40
State Institutional Strengthening	205.80	349.72	170	9.00	9.70	108
Basic Safety Facilities	604.50	797.09	132	27.00	21.88	81
Remedial Works	3,431.10	2,794.87	81	147.10	76.21	52
Total Project Costs	4,559.80	4,229.50	93	196.80	115.18	59

5.4.2 The costs incurred in Rupees are about 93 percent of the appraisal estimate but, due to the substantial change in exchange rate between the dollar and the Rupee, when expressed in dollars, costs are about 41 percent less than those estimated at appraisal. Institutional strengthening exceeded the SAR estimate by 70 percent in Rupee terms and 8 percent in dollar terms, due in part to the longer project duration. Basic safety facilities exceeded appraisal estimates in Rupees by 32 percent but were about 19 percent less in dollar terms. The main reason for the overall reduction in project costs in Rupee terms (by 7 percent) was the reduction in costs of the remedial works, due mainly to lack of accurate estimates at appraisal but also to the disbursement and implementation delays described above.

5.4.3 The Borrower's performance with accounting, financial reporting, and auditing requirements was generally satisfactory though on several occasions the audit reports were submitted after the due date resulting in suspension of disbursements based on Statement of Expenditure (SoE) procedure. Some of the audit reports had disallowed certain expenditures for which appropriate action was taken by the Bank to disallow those expenditures from the withdrawal applications. Since the project was appraised in 1990, the stringent financial management reviews now specified in OP/BP 10.02 were not undertaken. In spite of this the project's financial management was satisfactory.

6. Sustainability

6.1 Rationale for sustainability rating:

6.1.1 Overall the project benefits are assessed as *likely to be sustained*. Concepts of dam safety as implemented in the project have been agreed and adopted by the CWC and the four participating states. In Madhya Pradesh and Rajasthan (and to a lesser extent in Orissa), the DSOs have been made permanent organizations and are likely to remain effective and sustainable. Many incremental staff are in permanently established posts. However in Tamil Nadu sustainability appears much less likely unless staff numbers are restored as advised by the GOTN to the ICR mission. Concerning the physical works, it is anticipated that with the level of safety of dams raised through provision of basic safety facilities and carrying out the remedial works, most of the special and expensive repairs expenditure have been incurred (these components together constituted 88 percent of the project cost). Consequently, the provision of funding for O&M, normally provided by the states on a per ha of cultural command area basis, would enable an improved routine maintenance of the dams and thereby enhance sustainability of project benefits. Dam safety awareness raised by the project is expected to contribute to the mobilization of O&M funds in a positive manner.

6.1.2 Nevertheless there are several areas for concern. The benefits achieved by training staff in dam safety matters are unlikely to be sustained if staff are rotated away from work related to dam safety. There is an urgent need to ensure that operation rules (subjective or otherwise) and dissemination of knowledge relevant to these rules should trickle down to the dam operation level where there is less turnover of operating staff than in the upper management and supervisory levels. User friendly decision support systems specially designed to help the operator to do his work intelligently can go a long way in sustaining the outcome of the project.

6.1.3 It is worrisome that 51 percent of respondents to the Beneficiary Survey considered the states not to be in a position to sustain the dam safety program. One can interpret this as reflecting a desire for inclusion in a follow-up dam safety project in order to better ensure the necessary funds for the state DSOs. This is a cause for concern since this reflects an anxiety on the part of the stakeholders that the project may not be sustainable unless it is quickly backed up by a follow on project. During the stakeholders' workshop, participants (primary respondents in the beneficiary survey) also expressed keen interest in a follow-on project.

6.1.4 Although the quality of workmanship does not always meet international standards (the stakeholders' workshop drew attention to the need for more training in construction quality control), there is no reason to doubt the quality of the remedial works that have been completed. However, it is significant that many of the remedial works were in fact deferred maintenance caused by insufficient budget for maintenance in the past. It is extremely important that needs-based O&M assessments are regularly undertaken before the annual budget exercise and adequate provisions made. The states should move away from the present practice of clubbing the financial requirement of O&M of dam and distribution networks

of irrigation water supply. This would better ensure that adequate budget will be secured for the long term maintenance of the dams. The adequacy of O&M funds is a general problem of the water sector, rather than of dam safety in particular, but it clearly has relevance for dam safety as well.

6.1.5 In the long-term it is important to recognize that flood forecasting systems have a limited life due to deterioration of equipment and the continuing improvement of hardware and software. Once they are completed, sustainability will depend on periodic expensive replacing and upgrading the system every five to ten years.

6.2 Transition arrangement to regular operations:

6.2.1 There are no particular transition arrangements to regular operation. The DSOs in CWC and in the project states (with the possible exception of Tamil Nadu) are expected to continue to function satisfactorily, as will the State Dam Safety Committees. O&M of the project dams will continue to be the responsibility of the relevant river basin chief engineers. The states should ensure continuity of staff posted in DSOs (Tamil Nadu should restore the staff strength quickly as promised) and perform all the operations performed during the project (Phase I1 safety inspection; Phase II2 investigations; pre- and post-monsoon inspections; prioritizing dams needing remedial works; periodic meeting of state DSCs, etc.).

1. Phase I is an inspection to assess the general conditions of a dam and to determine the need for any additional engineering investigation and analysis, including hydrological.

2. Phase II investigations are performed where the results of the Phase I inspection indicate the need for additional investigation and studies.

7. Bank and Borrower Performance

Bank

7.1 Lending:

7.1.1 The project was the first Bank stand alone dam safety project, and considerable credit must be given to the initiative to mount such a program. India was well suited for this first initiative as it ranks third in terms of number of large dams in the world (China, the United States, and India), and India showed receptivity for such a program. Project identification also responded to repeated design problems with existing dams in ongoing Bank assisted projects. It was inevitable that the initiative would encounter many unforeseen difficulties, and that both preparation and implementation would entail some mistakes, and require learning and adjustment. Many innovations had to be introduced. Promoting a project such as this in India, requiring the harnessing of GOI's participation, and the participation of the states, was a significant achievement.

7.1.2 As discussed in section 3.4, there were a number of weaknesses in project preparation and appraisal resulting in weak quality at entry and which beset project implementation through most of its life. During preparation the Bank accepted assurances from the implementing agencies concerning the state of preparation of the hydrological analysis of project dams that turned out to be too optimistic. The large impact of the revisions of flood inflows in some important cases was not anticipated. Where structural solutions were hard to define, remedial works were not specified. The Bank insisted on the inclusion of very technically advanced flood forecasting systems against the wishes of the Borrower, who expressed before and during loan negotiations a desire to delete this component from the project. The Bank did not sufficiently emphasize in the SAR the need to establish clear operating rules for dams with gated spillways. The implementation plan and performance indicators were also weak, and there was no attempt to estimate the benefits due to the project works.

7.1.3 With the wisdom of hindsight, more importantly the over-optimism concerning the time required to establish and build the new institutions, especially at state levels, and to establish and work through the many new technical procedures and to agree on the various hydrological parameter estimates. At appraisal, the capacity of CWC to coordinate project implementation was also overestimated. As a result, implementation took about two to three years longer than anticipated to get significantly underway. A better course of action would have been to reduce the scope of physical works by about one-third to half, or to build in a two to three year start-up phase with recognized low activity on physical works, or to delay appraisal till the remedial measures for the bulk of Category I dams had been fully worked out. Notwithstanding the innovation of this pioneering program, performance at this juncture contained critical weaknesses and the Bank's lending performance is assessed as **unsatisfactory**.

7.2 Supervision:

7.2.1 The Bank's supervision is rated as **satisfactory**. Supervision missions were regular, thorough, and contained the expertise required to steer of the project. Through persistent efforts the CWC and the states were assisted in resolving the various bottlenecks confronting the project, and by the end of the project, albeit with a two-year extension, the project was able to largely meet its development objectives and physical targets. Skill-mix covered the core disciplines required in design and construction, hydrology, institutions, procurement, disbursement and economics. Substantial technical assistance was provided to the states and CWC, which helped create the various technical and institutional innovations introduced under the project. In the beneficiary survey 27 percent of respondents rated the Bank's performance as "highly satisfactory", and a further 50 percent as "satisfactory", with only 7 percent rating Bank performance as **unsatisfactory**.

7.2.2 Bank management decisions were also largely appropriate. Cancellation of the loan was done in 1995, a first restructuring and part cancellation of the credit in September 1997, and a second in September 1998. In hindsight, the first restructuring could have been effected earlier; possibly in 1995 after the end-1994 MTR. The caution of not considering the request of GOI for inclusion of Uttar Pradesh in the project after MTR was appropriate in view of project experience with the time required for a new state to gear up its program. The extension in September 1998 did not include Tamil Nadu based on agreed parameters between the Bank and the GOI and was appropriate given Tamil Nadu's poor performance. The decision of allowing an initial one-year extension with conditional agreement in principle for a second year extension providing that strict performance and implementation acceleration conditions were met, has also been largely responsible for the project's significant acceleration in implementation and performance in the last two years. Without the two year extension the project would have fallen significantly short of its development objectives and implementation targets.

7.3 Overall Bank performance:

7.3.1 Overall the Bank helped introduce and implement a pioneering project in a technically difficult field with limited experience on which to base decisions both at appraisal and during implementation. Some appraisal mistakes were inevitable, as they were also during implementation. The persistence and adaptability of the Bank team in correcting and adjusting as project experience developed, contributed to an overall satisfactory project outcome. Overall Bank performance has been assessed as **satisfactory**.

Borrower

7.4 Preparation:

7.4.1 The performance of the Borrower at preparation has been rated as *unsatisfactory*. As discussed in section 3.4, there was considerable overestimation of the state of preparedness of the hydrological analyses necessary for implementation of remedial works.

7.5 Government implementation performance:

7.5.1 **Government implementation performance** was generally *satisfactory*. Support was provided to the project, and the various restructurings and part cancellations were agreed to. The project was also periodically reviewed by DEA and MOWR along with the Bank and the implementing agencies. A significant shortcoming was that, although the Bank advanced 25 percent of each year's budget for project works to the GOI at the start of each financial year, this was generally not all passed on to the states. There was also a national ban on recruitment which contributed to delay of specialized work.

7.6 Implementing Agency:

7.6.1 **The implementation agencies' performance** progressed from problematic in the project's initial phase to generally *satisfactory* in the final years. The fundamental achievement was that the new institutions were created and became progressively operational by project completion, and physical targets were substantially met. With the exception of Tamil Nadu discussed above, both the central and state agencies had, by project completion, reached largely satisfactory performance levels. In the beneficiary survey conducted at the end of the project, only 2 percent of the respondents rated the performance of the central agency as unsatisfactory, while the corresponding figure for the state implementing agencies was 8 percent.

7.6.2 Nevertheless the bottom-line achievements above, examination of implementation details raise a number of shortcomings which, if they had been addressed would have improved outcome and the pace of implementation: (a) DOI/DOWR and their consultants were slow in agreeing hydrological and other design parameters and in finalizing detailed designs; (b) the project completion report prepared by Rajasthan DSO states that the services provided by its consultant were not of good standard; (c) there were considerable delays in the award of major contracts for the remedial works due to slow approval of the contracts by state authorities; (d) several major construction contracts were poorly managed by the states, which contributed to the delay in project implementation; (e) the funds required for construction were frequently not available when needed; (f) budgets for maintenance have sometimes been neither needs-based nor sufficient; and (g) the procurement and installation of novel instruments and dedicated software for the flood warning system were more than three years behind SAR's schedule due to differences of opinion between CWC and the Bank on design modalities and on deployment of staff. Finally, some important opportunities afforded by the project were foregone. For instance, advantage was not taken of the opportunity to study fully the possible ways of dealing with the revised design flood at Gandhisagar dam and at the three downstream dams (see Annex 7.5). The implementing agencies also did not evaluate the environmental impact of project works, which would have given good opportunity to stress the environmental improvements resulting from the enhanced safety of the dams.

7.7 Overall Borrower performance:

7.7.1 By project completion the institutions had developed significantly, technical expertise had increased, and physical targets had been substantially met. Since the project has been successfully completed, with progressively improved implementation over time, the borrower's overall performance is considered *satisfactory*. This assessment is corroborated in the beneficiary survey results, where 80 percent of the respondents rated the performance of the borrower as either satisfactory or highly satisfactory.

7.8 Beneficiary Survey :

7.8.1 The survey included the implementing agencies, contractors, consultants, farmers, academia, experts, and dam safety panel members as all of them had benefited either directly or indirectly from the project. A detailed questionnaire was prepared and circulated. The questionnaire attempted to elicit response from the beneficiaries on issues related to project relevance, investment priority, project objectives, project design, implementation of project components, performance of relevant project agencies, and issues related to agency coordination and project achievement. The respondents consisted of implementing agencies (31), dam safety review panel members (12), farmer representatives (2) and consultants, experts and contractors (13). Detailed results are in Annex 8, with a summary provided below:

Query	Response
Project relevance	Highly Relevant (62%), Relevant (38%)
Achievement of objectives	Fully (28%), Partially (60%), Not achieved (7%)
Consistency of project design with objectives	Consistent (52%), Needs major changes (36%)
All necessary components considered	Yes (49%), No (40%)
Central agency performance	Highly satisfactory (22%), Satisfactory (61%), Unsatisfactory (5%)
States' performance	Highly satisfactory (12%), Satisfactory (43%), Unsatisfactory (6%)
Bank's performance	Highly satisfactory (27%), Satisfactory (50%), Unsatisfactory (7%)
Impact of training on quality of work	Substantial (32%), Marginal (23%), Nil (12%)
Basic safety facilities adequately provided for	Yes (56%), No (28%)
Duration taken for finalizing the design flood	> 2 years (38%), 1-2 years (20%), < 2 years (2%)
Sustainability of DSOs	Certain (20%), likely (36%), pre-project status (9%)
Provision of O&M funds	Provided (71%), Token/no provision (29%)
Sustainability of DSP by states	Yes (49%), No (51%)

7.8.2 Overall the response appears to be consistent with the ratings indicated in the earlier paragraphs. A good number of respondents felt the need for major changes in project design, thereby suggesting a need for improvement of quality at entry. They also felt that finalization of the design flood has taken substantial time. They seem to be generally pleased with the performance of all the agencies. On the question of sustainability the impression is even. The question area here is likely to reflect both the weak past performance of state governments in maintaining infrastructure and supporting institutions not related to construction, and the possible influence in responding to this question of strong requests by stakeholders for a Bank funded follow-on project.

7.9 Stakeholders' Workshop (November 11-12,1999, New Delhi):

7.9.1 The aim of the workshop was to share the experience of a diverse set of stakeholders, consisting of officials from the GOI, state governments, consultants, contractors, nongovernmental groups, experts, academia, legislators and farmer representatives on design, implementation and outcome of the Dam Safety Project. This was expected to lead to: (a) greater understanding of implementation issues of the project; (b) objective assessment of the achievement of the project; (c) coordination issues relevant to project design and implementation; and (d) lessons learned to be used in the event of a follow-on project. There were 78 participants representing the MOWR, Department of Economic Affairs (DEA), CWC, engineers from the implementing states of Orissa, Tamil Nadu, Rajasthan and Madhya Pradesh; National Planning Commission, Dam Safety Review Panel chairmen and members, academia, Central Board of Irrigation and Power (representing the Indian National Committee on Large Dams), the International Commission on Irrigation and Drainage, representatives from primary beneficiaries (farmer representatives, ex-member of the legislative assembly); contractors and consultants; and the World Bank and FAOCP. The project's **implementation issues; concept/design issues and outcome/benefit issues** were discussed in three parallel group sessions. The recommendations of these groups were presented and discussed in a plenary on November 12, 1999, and final lessons learned and recommendations discussed and summarized. The key recommendations are:

- It is necessary to define the benefits of project works. This should be done with the participation of beneficiaries and those affected by the project, both upstream and downstream of the dam.
- Dams selected for remedial works and provision of basic facilities should be prioritized according to the benefits and costs.
- Clear terms of reference are needed in the project documents for all parties involved with the selection, investigation and design of project works, including consultants, Dam Safety Review Panels (DSRP), CWC, and others.
- DSRPs are a requirement of the World Bank for all dams associated with Bank projects. They should be advisory only and their terms of reference (TOR) should clearly indicate time allowed for their operation.
- Private consultants have their role. Their TOR should be time bound. A possible way to improve performance would be to give consultants contracts with short duration--if they do not perform satisfactorily, their contract would not be renewed.
- CWC should not act as hydrology consultants when they have authority to approve design

floods. CWC's other main purposes as far as dam safety is concerned should be the production and dissemination of guidelines and training.

- Wherever practical, training should be given on the job.
- Continuity of personnel would greatly improve implementation efficiency and dam safety.
- Availability of funds for construction was a problem during implementation. The Bank advances 25 percent of the year's budget but this does not reach the implementing agencies. It was suggested that borrower should ensure that implementing agencies have funds available at the start of the financial year, particularly when this coincides with the construction season.
- Many reservoirs with gated spillways do not have clear detailed operating rules. A straightforward procedure for deriving such operating rules was described to the workshop participants. This should be adopted for all reservoirs with gated spillways. The responsible chief engineers should be instructed to ensure that this is done.
- Emergency action plans are required for all reservoirs. They should be made with public participation and should be published. A paper by the United States Bureau of Reclamation on emergency preparedness plans was distributed to all participants at the workshop.
- There is a need for legislation to ensure that dams are safe--a draft is under preparation by CWC on behalf of the National Committee on Dam Safety.

8. Lessons Learned

8.1 The project was the first stand alone dam safety project financed by the World Bank, and as such, the lessons emerging are of particular interest. For India, the project introduced new ways of tackling dam safety, many unfamiliar technical skill requirements, and the creation of new institutions at state levels, substantial upgrading of institutions at central level, and the coordination between different institutions both within states (the DSC, DSO, and DSRP) and between the state institutions and the center. Although many teething problems were encountered, and there is still much to do to upgrade dam safety capabilities, a strong start has been made. Much can be learned by other states and countries, and by India's central agencies and implementing states, from the generally positive progress made under this project. In a more general sense, the project illustrates that the embarkation on a project in a new field for Bank involvement, also requiring substantial new technical areas for a borrower and new institutions for implementation can be made to be a success, albeit not without attendant issues and shortfalls.

8.2 The principal general lesson from the project is that in circumstances with new ideas and institutions, realism is needed in design and planning, and adequate time is required for implementation. Either the preparation phase or the time allowed for the implementation should have been different from those allowed under this project. If the former, the project should have been better prepared by completing hydrological estimates and have agreed designs for remedial works to be carried out in the first two years of the project approved by the financial and administrative authorities in the state before appraisal, and the new institutions established before implementation. If the latter, an institutional development and design phase of at least two years should have been incorporated in the project from the outset.

8.3 The project and the processes used in this ILI, have additionally brought out a great many technical issues in design, implementation, institutional, and coordination--these are summarized below:

- **Hydrological work takes a long time** to collate data for rainstorms, to define PMP and unit hydrographs and to agree revised design floods, often two to four years. As indicated above this period should be duly taken care of either in the preparation phase or implementation phase or an explicit up front integration in both the phases. Highly technical components, such as flood forecasting using telemetry, risk analysis, and some other specialized areas must be thoroughly prepared before appraisal, using international consultants where necessary. The use of new instrumentation requires training of the personnel concerned. Where practical, the supply and installation contract should include a component for on-the-job training. The project design should incorporate development of computer data bases incorporating historical major flood hydrographs and corresponding storm data, software for analysis, and graphical user friendly interfaces.
- **The need for detailed discussion:** It is important to adequately define the time frame and sequencing of analysis and design of remedial works to avoid delays. The capacity and established responsibilities of implementing agencies need to be evaluated during project preparation and their project responsibilities, including the relationship between DSO and other units, clearly defined based on this evaluation. Future projects should recognize the difficulties in agreeing design criteria.
- **The engineering of dams is a specialized subject.** Training in dam safety should be institutionalized so that all engineers in DOI/DOWR routinely receive dam safety training or a separate cadre of dam engineers should be established. Engineers in charge of dams must have adequate training and experience. The frequent rotation of experienced staff away from dam related work should be minimized.
- **It is important to prioritize investments** according to appropriate risk analysis and not on limited parameters such as dam height and reservoir volume but taking account of the extent of potential loss of life and physical damage downstream. In those countries where they exist at all, guidelines relating to risk analysis are still at an early stage and even ICOLD has yet to finalize such guidelines. In India, draft guidelines prepared under the project with the help of consultants, are being finalized by CWC through the National Committee on Dam Safety. When finalized these guidelines should enable prioritization of dams needing remedial measures, albeit initially with limited risk analysis.
- **Dam safety review panels** should be advisory only and should not be required to approve studies or designs. The selection of members of dam safety review panels should be made very carefully to ensure that those selected are capable of reaching sensible conclusions quickly. It may be advantageous to include at least one international expert in the panel to incorporate international experience in arriving at innovative solutions to the remedial works needed and flood forecasting aspects.
- **States generally do not have adequate hydrological capability** to estimate design floods and review flood operating strategies. There is a need for more specialization and the development of experience in specific fields. Flood analysis, flood forecasting and reservoir operation and the other aspects of the hydrology of reservoirs is one such field where specialization is desirable. Frequent transfer of engineers who have received specific training is counter-productive. There is a need for much more review and analysis of historical events to

understand why floods in excess of previous designs were passed without undue damage or difficulty and as an aid to formation of future operational strategies.

- **Systemic problems in project implementation need to be avoided:** Uncertainty in the flow of funds deters good contractors from bidding for the works. Procurement is slow. Contract management by DOI/DOWR needs improvement. The stakeholders' Workshop drew attention to the need for more training in Bank procedures and contract management.
- **O&M manuals should take account of dam safety plans** (including O&M, instrumentation, and emergency preparedness), which should be drafted early in the rehabilitation process and progressively updated during implementation. Problems identified with the remedial works should be reflected in revision to O&M manuals. Operating instructions should incorporate design assumptions, such as expected erosion downstream of spillway energy dissipaters, pore pressure readings, expected displacement, etc. The results of periodical readings of monitoring instruments installed in the dams should be analyzed and the findings should be incorporated in the annual O&M program, if necessary. Although implementation of the project has been generally satisfactory, assurance against dam safety related disasters is a continuous and ongoing process and further strengthening of institutions, procedures and technical capacity in the project states are required.
- **There is a need to assign responsibility for resolving safety issues and taking decisions on how to operate dams and cascades of dams on interstate rivers.** There is a need for clearer guidelines on responsibilities, and perhaps the need to develop or improve river basin authorities or boards which could expedite and guide the actions needed. The prime example of this problem is the Gandhisagar to Kota cascade on the Chambal River where a major review of all options is needed.
- **Reservoir operation rules for many reservoirs are inadequate.** There is a need to define rule curves for reservoir gate operation during floods to ensure more effective control of flood attenuation to optimize downstream benefits and to deliver benefits from flood forecasting. Such rules should be prominently displayed in the operating room at the dam and the authority to apply them should be unambiguous. With the improvement in information technology normal operation rule curves should be replaced by a **computerized decision support system** for safely passing the flood and online help for training the ever changing staff/operators to sustain the knowledge gained during the implementation of the project.
- **There is an urgent need for review of spillway capacities of dams in other states.** Many old dams in India (and elsewhere) were designed for floods which are much too low by modern standards. The project has remedied this situation at many dams in the four project states, where it was found that design floods had been underestimated, often by as much as a factor of three. This indicates that a review in other states is likely to result in remedial action being needed in many cases.

8.4 Looking to the future, it would clearly be important for India to continue and further develop its dam safety program. Considerable interest has been expressed by India in a Bank-supported follow-on project. This message also came clearly during the deliberations of the stakeholders' workshop and the views expressed by the chairpersons of various sessions in the workshop from the MOWR, National Planning Commission, and the CWC.

9. Partner Comments

(a) Borrower/implementing agency:

(Comments on the ICR have been received from the Department of Economic Affairs (DEA), Ministry of Finance, GOI the Ministry of Water Resources and the participating states in the program, viz., Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu. These are reproduced below verbatim. The comments were discussed with the agencies and suitably incorporated in the ICR text, where considered acceptable. Most of the comments support the views of the ICR. The comments do not materially change the substance of the ICR nor any questions raised on the ratings given in the ICR.)

Letter from Ms. Rachna Shah, Under Secretary (FB), DEA

Quote Dear Mr Jagannathan:

Please refer to your letter dated 16.2.2000 addressed to Secretary, MOWR and copied to us among all others concerned regarding Dam Safety Project (Credit No. 2241-IN) Draft Implementation Completion Report. This Department's comments on the draft ICR are as under:

The project was approved with a total credit of SDR 96.2 million and a loan of US\$ 23 million. Subsequently the entire loan was cancelled in July 1995 and credit amounting to SDR 20 million and 7.4 million was cancelled in July 1997 and September 1998 respectively. The likely utilization now is expected to be \$87.5 million which means that there would be a further cancellation of \$5.5 million.

While much of this is attributable to the depreciation of Rupee against the Dollar, it is also pertinent to note that the Project Implementation in the initial years was extremely slow. In the Remedial Works that were taken up under the Project, works at 33 sick dams were completed but half of these were not the ones that were originally identified. This reflects lack of adequate preparation and appraisal on the part of both the implementing agency and the Bank.

If a future project on Dam Safety is to come, one lesson that must be learned is that there has to be adequate project preparation before the project is negotiated so that the implementation can take off immediately after the loan is declared effective.

Bank in particular needs to take careful look at the design and preparation level of Projects to avoid such cancellations and delays.

We shall be grateful if the above comments are incorporated in the final Implementation Completion Report. Unquote

Observations of Ministry of Water Resources on the World Bank's Draft ICR on Dam Safety Assurance & Rehabilitation Project(Credit 2241-IN):

Ministry of Water Resources is of the view point that under mentioned paras of the Implementation Completion Report need modification:

Para 3. **Assessment of Development objective and Design, and of Quality of at Entry**

Para 3.1.2

It is reported that “These objectives were realistic and important for the country, which had many **dams that were unsafe**”

It is clarified here that at the time of their design, the dams were designed as safe as per design standards prevalent at that time. It is, therefore, not proper to say that dams were unsafe. Part of the sentence “many dams that were unsafe” may be substituted by the words “some dams that required safety review and strengthening”.

Similarly, in the sixth line "many large dams" may be substituted by "some large dams".

Para 3.5.3

In the 5th and 6th line it is mentioned “structural issues (such as adequate spillway capacity) were stressed, perhaps at the expense of nonstructural issues (spillway operation, flood mitigation). In this regard it is to state that due consideration was given to these aspects during implementation of the project and augmentation of the spillway capacity was resorted to only when it became essential.

Para 4 Achievement of Objective and Outputs

Para 4.1.2

From 7th to 9th lines it is mentioned “Thus, some 20 states (out of 25 states) are members of the National Committee on Dam Safety, with 12 states playing active roles. Considerable interest has also been expressed in a follow-on Dam Safety Project, with nine states requesting participation”

The statement may be corrected as thus, some 12 states (out of 25 states in the country), who own about 4251 large dams are members of the National Committee on Dam Safety, with all of them playing active roles. Considerable interest has also been expressed in a follow-on Dam Safety Project, with 11 out of these 12 states requesting participation. The 12th state has of late also shown interest for participation in the follow on Dam Safety Project.

Para 4.1.4 DOS in fourth line of this para may be read as DSO.

Para 4.1.8

With respect to interstate river basins, it is not correct to say that CWC is not playing a pro-active role. It is clarified that CWC has only an advisory role to play on projects/dams constructed on interstate rivers.

Interstate river disputes are to be resolved by the concerned states themselves. If not resolved, the state refer the dispute to Ministry of Water Resources, Government of India for resolving the issues amicably. However, if the issues still remain unresolved, interstate Water Tribunals are formed for resolution of such disputes/issues whose findings have legal sanctity. CWC plays an advisory role reinforced with technical data and analysis in resolving such issues/disputes between state Governments of the interstate river basins. Therefore, the wording of ICR in this respect needs to be suitably revised or deleted in view of the above explanation. However, the suggestion regarding the need to develop or

improve river basin authorities or boards on such interstate river basins is welcomed.

Para 4.1.10

It is clarified that normally in states, it is a practice to post officers having sufficient experience in hydrology in their hydrology units.

Para 4.2.1

It has been mentioned that CWC carried out hydrological review of 128 dams (appraisal estimate 170). Factual position is that under DSARP, CWC's Hydrology Studies Organisation has vetted/carried out hydrologic review of 62 dams only. In fact as per AGREEMENTS AND RECOMMENDATIONS of World Bank's SAR for this project (on page 19 of SAR) it is mentioned under para 4.2 that CWC Hydrology Unit would carry out design flood analysis for 33 identified dams and would make a review and give concurrence(vetting) of any flood hydrology analysis made by the states on other dams. This para needs correction as per the above noted observations.

Similarly CWC has carried out procedural clearance of 40 dams on which remedial measures were carried out for their rehabilitation against appraisal estimates of 33 dams. Structural reviews of dams identified for rehabilitation were carried out by state Governments through their design/units/consultants and agreed upon by Dam Safety Review Panels of the respective states.

Para 4.2.3

For overall development of the profession and their outlook, officers in CWC and the state Governments are being transferred to other fields but majority of their services are being utilised in the fields of their specialisation for purposes of continuity.

Para 4.2.7

The dams completed under remedial measures in case of Madhya Pradesh need to be corrected to read as on 91,8,3,5 and 10 instead of 91, 8,4,4 and 9. In view of this change, the table under this para also needs change. Similarly in para 4.2.6 of ICR, the number of dams where remedial works have been undertaken under Category I & II need to be revised as 16 & 17 respectively.

Para 5 Major Factors Affecting Implementation and Outcome

Para 5.2.1

The eleventh line of this para says, "In Rupee terms, the project by closure had spent 93 percent of the appraisal estimated project costs". The above may be substituted with, "In Rupee terms, the project at closure had spent 93 percent of the appraisal estimated project costs and 99.94% as per 2nd restructured cost of the project""

Para 5.3.1

For conducting design flood studies, observed rainfall and corresponding discharge data for several flood events at the dam site are essential. With these data, the response function of the basin, is computed. Despite repeated requests, during the initial stages of implementation of the project, the State Governments

could not supply the requisite data for most of the dams. Because of this, the studies had to be done by following a regional approach for developing the response functions. Since this methodology has its inherent limitations, attempts were made to collect as much information and data as possible and hence this was not attempted initially. There was also a need for a broad consensus on certain issues related to design storm estimation, which is a major step in design flood estimation. Towards this objective, a workshop involving eminent experts was held in December, 1993 in CWC and certain decisions were taken to rationalise the procedures. The recommendations of this workshop had significant impact on the outcomes of the hydrologic review. All these were contributing factors for the delay in completion of hydrological studies.

This aspect is now being attended to while preparing for the DSARP Project Phase-II to avoid delays in completing the hydrological reviews of the dams proposed by the States willing to joint the DSARP Phasse-II programme.

Para 5.3.3

It is not a correct observation by ICR that “in the initial years of the project, CWC had been pro-active even in the initial stages but due to the project being new and unique in its nature, some coordination delays in getting details from states and their compilation were encountered. In fact, during the last 2-3 years of the project, it was due to a very pro-active role of CWC which resulted in a very satisfactory and highly successful completion of the project.

Further, it is absolutely incorrect that there were serious differences between CWC and state Dam Safety Review Panels. This has not been substantiated in the ICR. In fact, all the hydrology reviews/vetting done by CWC were based on technical and hydrological analysis and finally accepted by state Governments and state DSRP’s for all the dams identified for receiving remedial works.

Furthermore, it is not correct that there was an overlap of the roles of CWFC as an approving authority and as consultants. In fact, for hydrology studies/reviews, some of the participating states did not have sufficient expertise in the field of hydrology during the initial stages of project implementation and CWC acted as an expert advisory in this specialised field and not as a consultant in any sense. Rather, the state engineers were trained during hydrology review/vetting and implementation of the project to make them self-sufficient in this regard. CWC never charged any amount from the tates for hydrology reviews/vettings under the project.

Thus this para needs to be suitably reworded in light of above comments.

Para 5.4.1

Revised tables as per actual expenditure is given below:

Project component	SAR	Rs. In million Actual/ latest	Actual/ latest	SAR	\$ Actual	Actual SAR %
Institutional Strengthening (CWC)	68.30	113.43	166	3.00	3.10	103
Flood Forecasting Systems(CWC)	250.10	174.39	70	10.70	4.29	40
State Institutional Strengthening	205.90	349.72	170	9.00	9.70	108
Basic Safety Facilities	604.60	797.09	132	27.00	21.88	81
Remedial Works	3431.10	2794.87	81	147.10	76.21	52
Total Project Costs	4560.00	4229.05	93	196.80	115.18	59

The table given in the draft ICR, therefore, needs to be corrected accordingly.

Para 7 Bank and Borrowers Performance

Para 7.1.3.

As already communicated against para 5.3.3, some problems were encountered during the initial stages of the implementation of the project but these were duly compensated during the last 2-3 years by accelerated implementation of the project. However at no stage did the borrower express the desire to delete this component from the project.

Para 7.6.2(item vii)

It may be clarified that CWC could really start its work on the modernisation of flood forecasting in two basins, viz. Mahanadi and Chambal basin only after getting approval of the World Bank in January, 1995.

Comments received from Government of Madhya Pradesh (Bhopal)

Assessment of development, objective and design and of quality at entry:

Comments: No comments.

Achievement of objectives and outputs:

Comments: The state has adequate capabilities to estimate the design flood and review flood operating studies. There is a correction in the table below point 4.2.7. The correction is with respect to the state of Madhya Pradesh. The corresponding figures should be 91, 8, 3, 5, and 10 instead of 91, 8, 4, 4, and 9.

Major factors affecting implementation and outcome:

Comments: No comments.

Sustainability:

Comments: The state of Madhya Pradesh has at many occasions, expressed its commitment to continue the dam safety programme in the state. The state understands that at least a period of six years is required to consolidate the dam safety institution installed and procedures established during Dam Safety Project-I. However to take up the dam safety works in all such dams, it is beyond the state's present financial capabilities. As the state has well-established institutional back up, the implementation of dam safety programme at field level, can start immediately if the funds are made available by any external agency. In fact the state has advanced preparedness to execute the Dam Safety Project proposed to be undertaken later, by the World Bank as Dam Safety Project II.

Lessons Learned:

Comments: To fix the priority in selecting the safety and other related works in a distressed dam on the basis of risk analysis is at present not possible. The National Guidelines in this issue are in the draft stage and may take sometime to come to practice and will overtake much longer time to become a good practice. As has been debated all over the World, the factors dam height and the volume of reservoir are still accepted as indicators to assess the hazard potential. The state has already considered the effect of loss of property and life by fixing the priorities of dams with respect to its location and distance from upstream of a village, township, district headquarter and big cities. The present procedure is to identify the distressed dams through visual inspection and prioritize them on the basis of their location and potential hazard to the life and property.

There are over 1000 dams in the state, which are to be prioritized on the basis of risk analysis approach. This required approved set of guidelines, for the study and financial resources, to carry out such studies. In the present scenario, it cannot be achieved.

The state has capabilities to handle the hydrology of the project and floods and thus differs from other states. This is one of the strong reason for the state so as to claim the World Bank assistance for the follow-on Dam Safety Project, Phase II.

The state has started to review the O&M manuals of all the dams which are in use since their operation and likely to complete by end of December 2000.

Comments received from the Government of Rajasthan (Jaipur)

Para 1 Principal Performance Ratings

Comments: Agreed

Para 3.5 Quality at Entry - Unsatisfactory

Comments: Agreed

Para 4.1.1 Achievements of Objectives & Outputs – Output is rated as Satisfactory

Comments: Agreed

Para 4.1.3 Rajasthan DSO Institutional Concept

Comments The DSO will be continued

Para 4.2.2 Institutional Strengthening of DSO – staff in place = 77

Comments Likely to be continued

Dams News/Newsletter

Comments Being published regularly

Para 4.2.7 Basic Facilities Completed – on 60 Dams
Remedial Works

Completed Cat, I	Partial Comp. Cat. II	New Com. Cat. III
4	3	3

Comments Agreed

Completed Cat, I	Partial Comp. Cat. II	New Com. Cat. III
5	2	2

Para 5 Major Factors Affecting Implementation & Outcome

Comments No comments

Para 6 Sustainability – likely to be sustained.

Comments Agreed

Para 7 Bank & Borrower Performance
- Overall Bank performance - Satisfactory
- Overall Borrower Performance - Satisfactory

Comments Agreed

Para 7.6.2 of As per the Project Completion Report of Rajasthan, Consultant Services were not good standard.

Comments	Agreed									
Annex 1 Pag 23-25	Output Indicators									
Comments	Agreed									
Page 25	Phase I Inspection of 176 dams - Completed									
Comments	186 (125 identified + 61 newly identified) - Completed									
Annex 2 Page 30	Project Cost by Component - Rajasthan State million Rs.									
Comments	Final figures are as under:									
	<table> <tr> <td>Inst. Strengthening</td> <td>134.17</td> <td>139.383 M</td> </tr> <tr> <td>Basic Safety Facilities</td> <td>246.68</td> <td>247.135 M</td> </tr> <tr> <td>Remedial Works</td> <td>697.78</td> <td>710.290 M</td> </tr> </table>	Inst. Strengthening	134.17	139.383 M	Basic Safety Facilities	246.68	247.135 M	Remedial Works	697.78	710.290 M
Inst. Strengthening	134.17	139.383 M								
Basic Safety Facilities	246.68	247.135 M								
Remedial Works	697.78	710.290 M								
Page 31-39	Various Annexes									
Comments	No comments									

Comments received from the Government. of Tamil Nadu (Chennai)

Regarding sustainability and continuity of the Dam Safety Organization, I am directed to state that as the credit facilities were withdrawn from 30.9.98 onwards, the staff were redeployed for the works related to Dam Safety Works only. The Dam Safety Organization is functioning now and the staff strength would be increased as and when required (ii). Regarding adequacy of budgetary provision for the long term maintenance of the dams rehabilitated, I am to state that adequate funds will be provided in the budget for every year for the maintenance of the dams for which rehabilitation works have been taken up. (iii) Regarding emergency preparedness plan, I am to state that the approved emergency preparedness plans for rehabilitated dams will be prepared after getting a final report from the consultant for WRCP project, for whom the task of operation and maintenance has been entrusted (iv) Regarding frequent transfer of key staff handling reservoirs, I am to state that generally the policy of this Government is to transfer the technical staff once in three years. However, while transferring the person care will be taken to post such persons, who have similar experience in safe operation of reservoirs with gated spillway (v) Regarding the project cost and financing furnished in page 30 of ICR, I am to state that, in World Bank letter dated 12.4.99, it was agreed to reimburse some of the expenditure on works which were executed before the closing date of 30.9.98. An amount of Rs. 25.51 lakhs was sanctioned and payment made. The vouchers were sent to World Bank for reimbursement during the first fortnight of Feb. 2000. The expenditure incurred are under Institutional Strengthening and under Basic Safety Facilities. Hence adding these expenditure the revised figures are as follows:

Inst. Strengthening	134.17	34.3262 M
Basic Safety Facilities	246.68	54.1976 M
Remedial Works	697.78	159.7709 M

Comments received from Govt. of Orissa (Bhubaneswar)

Project Data

Principal Performance Ratings

Assessment of Development Objective and Design and Quality at Entry (Original Objectives, Revised

Objective, Original components, revised components, quality at entry)

No comments

Achievement of Objective and Outputs:

- | | |
|-----------------|--|
| 4.11 to 4.1.6 | No comments |
| 4.1.7 | Agreed to Bank's comments. Specialized training should have been given to DSO personnel as well as design engineers who in turn will impart training to field engineers. |
| 4.1.8 | No comments |
| 4.1.9 | We fully agree with the views taken by the ICR Mission. Special care has been taken for preparation of Operation & Maintenance Manual of multipurpose projects. |
| 4.1.10 | The Irrigation Engineers of Orissa have adequate capability for hydrological study. The results of studies are referred to CWC only for the sake of vetting. |
| 4.1.11 | No comments |
| 4.2 | Outputs by components: |
| 4.2.1. to 4.2.2 | No comments |
| 4.2.3 | We fully agree with the views of the ICR Mission |
| 4.2.4 to 4.2.8 | No comments |
| 4.3 | Net Present Value/Economic rate of return: No comments. |
| 4.4 | Financial rate of return: No comments |
| 4.5 | Institutional development impact: No comments |
| 5 | Major Factors Affecting Implementation and Outcome: |
| 5.1 | Factors outside the control of government or implementing agency |
| 5.1.1 | No comments |
| 5.2 | Factors generally subject to government control |

5.2.1	No comments	
5.3	Factors generally subject to implementing agency control:	
5.3.1 to 5.3.3	No comments	
5.4	Costs and financing	
4.4.1 to 5.4.2	No comments	
6.	Sustainability:	
6.1	Rationale for sustainability rating	
6.1.1 to 6.1.3	No comments	
6.1.4	We fully agree with the views of the ICR Mission that budget provision be made for O&M for dam and Irrigation network separately.	
6.1.5	No comments	
6.2	Transition arrangement to regular operations:	
6.2.1	No comments	
7.	Bank and Borrower Performance:	
<u>Bank</u>		
7.1	Lending	
	7.1.1 to 7.1.3	No comments
7.2.1 – 7.2.2	No comments	

7.3 Overall Bank Performance
7.3.1 No comments

Borrower

7.4 Preparation
7.4.1 No comments

7.5 Government implementation performance
7.5.1 No comments

7.6 Implementing Agency:
7.6.1 to 7.6.2 No comments

7.7 Overall Borrower Performance
7.7.1 No comments

7.8 Beneficiary Survey
7.8.1 to 7.8.2 No comments

7.9 Stakeholders' Workshop, November 11-12, 1999, New Delhi
7.9.1 No comments

8 Lessons Learned:

8.1

8.2 The views of the ICR Mission are highly appreciated

8.3

8.4

9. Partner Comments: No comments

10 Additional Information: No comments

(b) Cofinanciers:
Not applicable.

(c) Other partners (NGOs/private sector):
Not applicable.

10. Additional Information

Listed in Annex 7

Annex 1. Key Performance Indicators/Log Frame Matrix

Annex 1. Key Performance Indicators/Log Frame Matrix

Outcome/Impact Indicators:

Indicator	Projected in SAR	Actual
Dam Safety Improved in project states	yes	yes
Dam Safety Inspection and Evaluation System Introduced		
Madhya Pradesh	Yes	Yes
Orissa	Yes s	Yes
Rajasthan	Yes	Yes
Tamil Nadu	Yes	Yes
Environmental Impact Assessments	Yes	No

Output Indicators:

Indicator	Projected in SAR	Actual/Latest Estimate
A. INSTITUTIONAL STRENGTHENING		
(1) CWC		
(i) Add Directorates To CWC	3	3
(ii) Incremental CWC Manpower:		
(a) Technical:		
- Chief Engineer's Office	1	1
- Monitoring Directorate	13	20
- Special Analysis Directorate	11	14
- Rehabilitation Directorate	7	8
- Hydrology Organization: Chief Engineer's Office	1	1
- Hydrology Organization: Review Directorate	22	23
- Flood Management	0	11
(b) Support:		
- Chief Engineer's Office	3	2
- Monitoring Directorate	11	8
- Special Analysis Directorate	8	4
- Rehabilitation Directorate	3	1
- Hydrology Organization: Chief Engineer's Office	3	3
- Hydrology Organization: Review Directorate	20	18
- Flood Management	0	3
Total	103	117
(2) States: Incremental Manpower		
(i) Madhya Pradesh		
(a) Technical		
- Dam Safety	24	31
- Hydrology, Structural and Others	26	19
(b) Support		
- Dam Safety	21	26
- Hydrology, Structural and Others	30	6

Total	101	82
(ii) Orissa		
(a) Technical		
- Dam Safety	25	25
- Hydrology, Structural and Others	17	17
(b) Support		
- Dam Safety	23	19
- Hydrology, Structural and Others	11	7
Total	76	68
(iii) Rajasthan		
(a) Technical		
- Dam Safety	27	21
- Hydrology, Structural and Others	14	18
(b) Support		
- Dam Safety	25	8
- Hydrology, Structural and Others	14	30
Total	80	77

Output Indicators (continued)

Indicator	Projected in SAR	Actual/Latest Estimate
(iv) Tamil Nadu		
(a) Technical		
- Dam Safety	22	4
- Hydrology, Structural and Others	12	0
(b) Support		
- Dam Safety	12	8
- Hydrology, Structural and Others	9	0
Total	55	12
Grand Total	415	356
(3) Preparation of Regional Maximum Precipitation Atlases	3	2
(4) Estimation of Design Floods for Dams by CWC Hydrology	33	62
(5) Training (SAR Annex 8)		
- Training Abroad for CWC – DSO Engineers	15 mm	13.0 mm
- Training Abroad for CWC – Hydrologists	15 mm	20.2 mm
- Training Courses at CWC	not specified	11 number
- CWC Workshops/Seminars	not specified	16 number
- External Consultants for CWC DSO	6 mm	18 mm
- Consultants for CWC Hydrology	6 mm	494 mm
- Study Tours CWC DSO	4 mm	1.8 mm
- Study Tours CWC Hydrology	4 mm	1.8 mm
- Training Overseas: Madhya Pradesh	15 mm	9.0 mm
- Training Overseas: Orissa	15 mm	10.0 mm
- Training Overseas: Rajasthan	15 mm	11.5 mm
- Training Overseas: Tamil Nadu	15 mm	(10 mm)
- State Workshops	10 number	8 number
Total		
(6) Hydrological Review (number of dams) (see SAR, p 69)		
- Madhya Pradesh	95	60
- Orissa	20	43

- Rajasthan	50	11
- Tamil Nadu	5	14
Total	170	128
(7) Structural Review (number of dams) (see SAR, p. 69)		
- Madhya Pradesh	20	19
- Orissa	0	7
- Rajasthan	24	13
- Tamil Nadu	0	10
Total	44	49
(8) Dam Safety Review Panels (number of meetings)		
- Madhya Pradesh		23
- Orissa		15
- Rajasthan		25
- Tamil Nadu		14
Total		77
(9) Phase I Dam Inspection (number of dams) (see SAR, p. 6)		
- Madhya Pradesh	608	1,081
- Orissa	131	196
- Rajasthan	124	176
- Tamil Nadu	84	57
Total	947	1,510
(10) Phase II Investigation (number of dams) (see SAR, p. 69)		
- Madhya Pradesh	75	28
- Orissa	25	25
- Rajasthan	25	13
- Tamil Nadu	22	15
Total	147	81
Grand Total		

Output Indicators (continued)

Indicator	Projected in SAR	Actual/Latest Estimate
B. BASIC SAFETY FACILITIES		
(1) Access Roads (number of dams)		
- Madhya Pradesh	yes	94
- Orissa	yes	15
- Rajasthan	yes	56
- Tamil Nadu	yes	16
Total		181
(2) Communication Systems (number of dams)		
- Madhya Pradesh	yes	45
- Orissa	yes	3
- Rajasthan	yes	60
- Tamil Nadu	yes	40
Total		148
(3) Standby Generators (number of dams)		
- Madhya Pradesh	yes	33
- Orissa	yes	6
- Rajasthan	yes	56
- Tamil Nadu	yes	8
Total		103
(4) Hydrological Instrumentation (number of dams)		
- Madhya Pradesh	yes	105
- Orissa	yes	15
- Rajasthan	yes	16
- Tamil Nadu	yes	36
Total		172
C. REMEDIAL WORKS		
(i) Madhya Pradesh		
- Category I		
(1) Aoda (Cat. C)	yes	completed

(2) Barna (Cat. C)	yes	completed
(3) Kotwal (Cat. A)	yes	partial
(4) Gandhisagar (Cat. A)	yes	completed
(5) Pagara (Cat. A)	yes	partial
(6) Pillowa (Cat. A)	yes	partial
(7) Tigra (Cat. B)	yes	partial
(8) Kaketo (Cat. C) (Dam was dropped in 1997 restructuring)	yes	not taken up
- Category II		
(1) Murransilli	no	completed
(2) Barchar	no	completed
(3) Maniyari	no	completed
(4) Dudhwa	no	completed
(5) R.S. Sagar	no	completed
(6) Sondur	no	completed
(7) Tawa	no	completed
(8) Sukta	no	completed
(9) Chandora	no	completed
(10) Sampna	no	completed
Total (including partial/completed only)		17/13
(ii) Orissa		
- Category I		
(1) Alikuan (Cat. C)	yes	(partial)
(2) Behera (Cat. C)	yes	completed
(3) Bhanjanagar (Cat. C)	yes	completed
(4) Darjang (Cat. C)	yes	completed
(5) Ghodahada (Cat. C)	yes	completed
(6) Hirakud (Cat. A)	yes	(partial)
(7) Jharnai (Cat. C)	yes	completed
(8) Soroda (Cat. C)	yes	completed
(9) Ganianala (Cat. C) (Dam was dropped in 1997 restructuring)	yes	(partial)
- Category II		
(1) Kansabahal	no	completed

(2) Kuanria	no	completed
Total (including partial/completed only)		11/8

Indicator	Projected in SAR	Actual/Latest Estimate
(iii) Rajasthan		
- Category I		
(1) Galwa (Cat. C)	yes	completed
(2) Jawahar Sagar (Cat. B)	yes	completed
(3) Kota Barrage (Cat. B)	yes	completed
(4) Matri Kundia (Cat. C)	yes	completed
(5) Parbati (Cat. C)	yes	(partial)
(6) Ranaprathap Sagar (Cat. B)	yes	completed
(7) Alnia (Cat. C) (Dam was dropped in 1997 restructuring)	yes	(partial)
- Category II		
(1) Jawai	no	completed
(2) Sei Diversion	no	completed
(3) Gambhiri (Dam was dropped in 1997 restructuring)	no	(partial)
(4) Moral (Dam was dropped in 1997 restructuring)	no	(not taken up)
Total (including partial/completed only)		10/7
(iv) Tamil Nadu		
- Category I		
(1) Gomukhinadhi (Cat. C)	yes	(partial)
(2) Kodaganar (Cat. A)	yes	(completed by State)
(3) Manimuthar (Cat. C)	yes	completed
(4) Pechiparai (Cat. C)	yes	completed
(5) Periyar (Cat. C)	yes	(partial)
(6) Santhanur (Cat. B) (Dam was dropped in 1997 restructuring)	yes	(partial)
(7) Uppar (Cat. C) (Dam was dropped in 1997 restructuring)	yes	(partial)
(8) Ponnaniar (Cat. C) (Dam was dropped in 1997 restructuring)	yes	(not taken up)
(9) Vidur (Cat. C) (Dam was dropped in 1997 restructuring)	yes	(partial)
- Category II		

(1) Gunderipallam (Dam was dropped in 1997 restructuring)	no	(completed by State)
(2) Willington (Dam was dropped in 1997 restructuring)	no	(not taken up)
(3) Siddhamalli (Dam was dropped in 1997 restructuring)	no	(partial)
(4) Sholayar (Dam was dropped in 1997 restructuring)	no	(Completed by State)
(5) Peruchani (Dam was dropped in 1997 restructuring)	no	(not taken up)
(6) Manimukta nadhi (Dam was dropped in 1997 restructuring)	no	(not taken up)
Total (including partial/completed only)		11/5
Summary by State ^{a/}		
- Madhya Pradesh	8	13
- Orissa	9	8
- Rajasthan	7	7
- Tamil Nadu	9	5
Total	33	33
Summary by Category ^{b/}		
- Category I.A	7	2
- Category I.B	5	3
- Category I.C	21	12
- Category II		16
Total	33	33

a/ SAR and DCA identified 33 dams (Category I dams) but allowed an additional Rs 337 million base cost (SAR page 96 – SAR page 55). Although not stated in the SAR, it is understood that the costs were based on 55 dams. However, Annex 13 of the SAR (page 100) shows an unknown number of Type D dams with construction starting after the end of the project, indicating that the Rs 337 million was to cover investigation and design only. Page 19 of the DCA (Annex to Schedule 2) refers to Category II dams, which would be inspected and investigated for the purpose of identifying required remedial works. Para 4 of Schedule 2 refers to carrying out remedial works at Category II dams set forth in the Annex. (See also SAR, pages 20-33 dams proposed for rehabilitation).

b/ Categories A, B, C are based on completeness of data at SAR.

Annex 2. Project Costs and Financing

Project Costs by Components (currency unit in million) Annex 2a

Project Component	Appraisal Estimate Rs	Appraisal Estimate \$	Latest Estimate Rs	Latest Estimate \$	Percent of App in Rs	Percent of App in \$
CWC Institutional Strengthening	68.3	3.0	113.43	3.10	166	103
Flood Forecasting Networks	250.1	10.7	174.39	4.29	70	40
Institutional Strengthening:						
- Madhya Pradesh	59.6	2.6	73.36	1.93	123	74
- Orissa	48.9	2.1	103.20	2.94	211	140
- Rajasthan	52.5	2.3	139.38	3.82	265	166
- Tamil Nadu	44.8	2.0	33.78	1.01	75	51
Total	205.8	9.0	349.72	9.70	170	108
Basic Safety Facilities:						
- Madhya Pradesh	280.2	12.3	403.00	10.64	143	87
- Orissa	133.4	6.0	94.80	2.85	71	48
- Rajasthan	109.8	5.0	247.14	6.89	225	138
- Tamil Nadu	81.1	3.7	52.15	1.50	64	41
Total	604.5	27.0	797.09	21.88	132	81
Remedial Works:						
- Madhya Pradesh	1059.1	45.9	837.09	23.04	79	50
- Orissa	1091.0	46.4	1105.25	29.73	101	64
- Rajasthan	700.9	29.8	710.29	19.04	101	64
- Tamil Nadu	580.1	24.9	142.33	4.40	25	18
Total	3431.1	147.1	2797.87	76.21	81	52
Grand total	4559.8	196.8	4229.50	115.18	93	59

* The table needs minor revisions in consultation with the borrower to be made consistent with the table given at para 5.4.1.

Project Costs by Procurement Arrangements (appraisal estimate) (\$ million equivalent) Annex 2b (1)

Expenditure Category	ICB	Procurement NCB	Method ¹ Other ²	N.B.F.	Total Cost
1. Works	0.00	132.90	10.00	0.20	143.10
2. Goods	7.70	7.40	3.50	0.00	18.60
3. Services	0.00	0.00	6.00	16.50	22.50
4. Miscellaneous	0.00	0.00	6.40	6.20	12.60
Total	7.70	140.30	25.90	22.90	196.80

**Project Costs by Procurement Arrangements
(actual/latest estimate) (\$ million equivalent)
Annex 2b(2)**

Expenditure Category	ICB	Procurement Method		N.B.F.	Total Cost
		NCB	Other ¹		
1. Works	0.00	95.10	0.90	0.90	96.90
2. Goods	3.40	2.70	0.20	0.00	6.30
3. Services	0.50	0.30	4.90	0.00	5.70
4. Miscellaneous	0.00	0.00	6.00	0.00	6.00
Total	3.90	98.10	12.00	0.90	114.90

¹ Includes civil works and goods to be procured through national shopping, consulting services, services of contracted staff of the project management office, training, technical assistance services, and incremental operating costs related to (a) managing the project, and (b) relending project funds to local government units.

**Project Financing by Category
(\$ million equivalent)
Annex 2c**

Component	Appraisal Estimate		Actual/Latest Estimate	Percentage of Appraisal	
	Bank	Govt.		CoF.	Bank Govt. CoF.
Land acquisition			0.20	0.100	0.050
Civil works	128.60		14.30	76.70	20.2059
Equipment and vehicles	13.70		4.90	4.00	2.3029
Training, TA, consultants	6.00			2.10	35.00
Design, staff, incremental costs	4.70		24.40	4.70	6.00100

Project Costs by Procurement Arrangements (Appraisal Estimate) (US\$ million equivalent)

Expenditure Category	ICB	Procurement Method		N.B.F.	Total Cost
		NCB	Other ²		
1. Works	0.00 (0.00)	132.90 (0.00)	10.00 (0.00)	0.20 (0.00)	143.10 (0.00)
2. Goods	7.70 (0.00)	7.40 (0.00)	3.50 (0.00)	0.00 (0.00)	18.60 (0.00)
3. Services	0.00 (0.00)	0.00 (0.00)	6.00 (0.00)	16.50 (0.00)	22.50 (0.00)
4. Miscellaneous	0.00 (0.00)	0.00 (0.00)	6.40 (0.00)	6.20 (0.00)	12.60 (0.00)

5. Miscellaneous	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
6. Miscellaneous	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Total	7.70 (0.00)	140.30 (0.00)	25.90 (0.00)	22.90 (0.00)	196.80 (0.00)

^{1/} Figures in parenthesis are the amounts to be financed by the Bank Loan. All costs include contingencies.

^{2/} Includes civil works and goods to be procured through national shopping, consulting services, services of contracted staff of the project management office, training, technical assistance services, and incremental operating costs related to: (a) manage the project, and (b) relend project funds to local government units.

Project Financing by Component (in US\$ million equivalent)

	Appraisal Estimate			Actual/Latest Estimate			Percentage of Appraisal		
	Bank	Govt.	CoF.	Bank	Govt.	CoF.	Bank	Govt.	CoF.
Land acquisition		0.20			0.10		0.0	50.0	0.0
Civil works	128.60	14.30		76.70	20.20		59.6	141.3	0.0
Equipment and vehicles	13.70	4.90		4.00	2.30		29.2	46.9	0.0
Training, TA, consultants	6.00			2.10			35.0	0.0	0.0
Design, staff, incremental costs	4.70	24.40		4.70	6.00		100.0	24.6	0.0

Annex 3: Economic Costs and Benefits

Not estimated.

Annex 4. Bank Inputs

(a) Missions:

Stage of Project Cycle	No. of Persons and Specialty (e.g. 2 Economists, 1 FMS, etc.)		Performance Rating		
	Month/Year	Count	Specialty	Implementation Progress	Development Objective
Identification/Preparation					
Appraisal/Negotiation December 1990	7	E, Ec			
Supervision					
Aug. 1991	3	EDS, Ec	S	S	
Mar/Apr 1992	2	Ec EDS	S	S	
Aug/Dec 1992	2	Ec EDS	S	S	
Apr 1993	1	EDS	U	S	
Oct 93/Feb 94	1	EDS	U	S	
MTR: Nov/Dec 1994	2	EDS	U	S	
Dec 1995	2	EDS	U	S	
Jan/Feb 1997	5	ED, EDS, Ec, I, P	S	S	
June 1997	5	ED, EDS, Ec, P, I	S	S	
Jan 1998	5	EDS, Ec, H, P, I	S	S	
Jun 1998	5	EDS, Ec, H, P, I	S	S	
Jan/Feb 1999	7	EDS, Ec, Ed, H, P, I	S	S	
ICR					
Oct/Nov 99	6	E H Ec	S	S	

(b) Staff:

Stage of Project Cycle	Actual/Latest Estimate	
	No. Staff weeks	US\$ (.000)
Identification/Preparation	86.9	181.5
Appraisal/Negotiation	28.3	78.8
Supervision	211.3	328.6
ICR	17.0 (est.)	60.0
Total	343.5	648.9

Annex 5. Ratings for Achievement of Objectives/Outputs of Components

(H=High, SU=Substantial, M=Modest, N=Negligible, NA=Not Applicable)

	<i>Rating</i>
<input checked="" type="checkbox"/> <i>Macro policies</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input checked="" type="checkbox"/> <i>Sector Policies</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input checked="" type="checkbox"/> <i>Physical</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input checked="" type="checkbox"/> <i>Financial</i>	<input type="radio"/> H <input type="radio"/> SU <input checked="" type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input checked="" type="checkbox"/> <i>Institutional Development</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input checked="" type="checkbox"/> <i>Environmental</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<i>Social</i>	
<input checked="" type="checkbox"/> <i>Poverty Reduction</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input checked="" type="checkbox"/> <i>Gender</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input type="checkbox"/> <i>Other (Please specify)</i>	
<input checked="" type="checkbox"/> <i>Private sector development</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input checked="" type="checkbox"/> <i>Public sector management</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Other (Please specify)</i>	

Annex 6. Ratings of Bank and Borrower Performance

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HU=Highly Unsatisfactory)

6.1 Bank performance

Rating

- Lending
- Supervision
- Overall

HS S U HU
 HS S U HU
 HS S U HU

6.2 Borrower performance

Rating

- Preparation
- Government implementation performance
- Implementation agency performance
- Overall

HS S U HU
 HS S U HU
 HS S U HU
 HS S U HU

Annex 7. List of Supporting Documents

- Annex 7.1 Aide-Memoire of the ICR Mission
- Annex 7.2 Review of CWC Activities in Hydrology
- Annex 7.3 Flood Operation of Reservoir with Gated Spillways
- Annex 7.4 Other Hydrological Aspects of the Project
- Annex 7.5 Gandhisagar Design Flood
- Annex 7.6 International Perspective on Dam Safety
- Annex 7.7 Review of Flood Hydrology at Hirakud

Annex 8. Beneficiary Survey Results

Description of Survey

Beneficiary Identification:

The main beneficiaries of the project would be the owners of the dams, which are the governments of the participating states. However, the survey included all classes of stakeholders (the implementing agencies, contractors, consultants, farmers or experts, and dam safety panel members) as all of them had benefited either directly/indirectly from the project.

Questionnaire:

A detailed questionnaire (see Appendix 1) was prepared and discussed. The questionnaire attempted to elicit response from the beneficiaries on issues related to project relevance, investment priority, project objectives, project design, implementation of various components under the project, performance of all the relevant agencies in the project and the issues related to their co-ordination and project achievement. Questionnaires were sent to about 75 persons and response has been received so far from 58 persons.

Respondents:

The respondents consisted of (see Appendix 2):

	Number	%
Implementing Agencies (state and central) Staff	31	53
Dam Safety Review Panel Members	12	21
Beneficiaries	2	4
Others (consultants, experts, contractors)	13	22
Total	58	100

Responses

Summary of Responses:

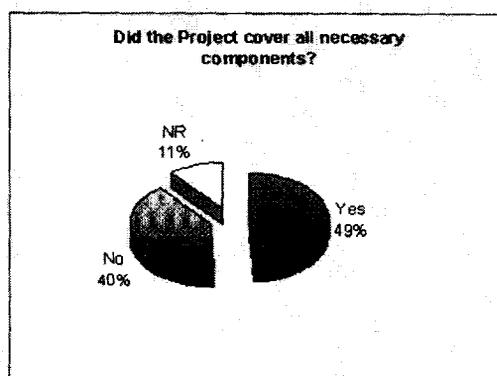
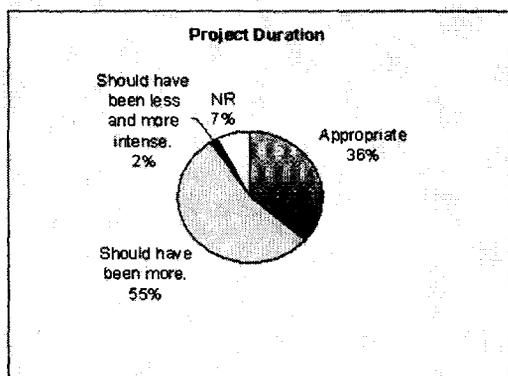
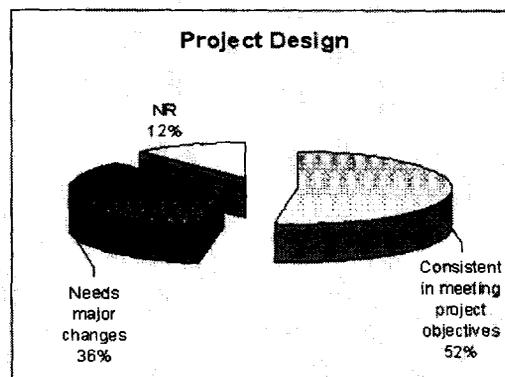
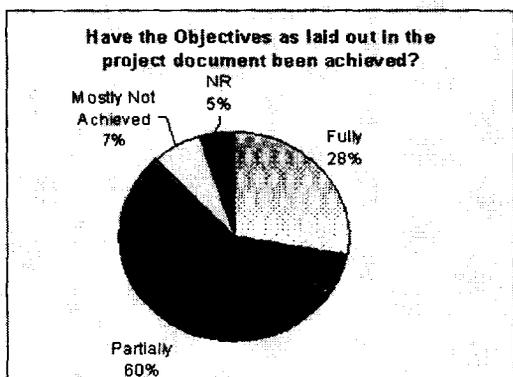
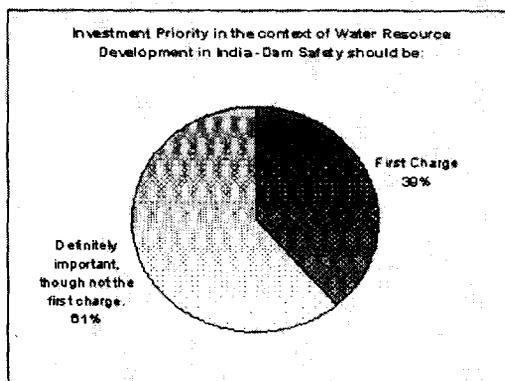
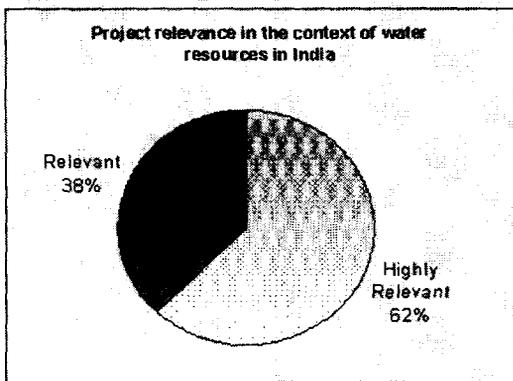
- About two-thirds of the respondents feel that the project is highly relevant in the context of water resources development in India.
- 39 percent feel that dam safety should be the first charge on investment in the water sector.
- 28 percent feel that the objectives have been fully achieved. 60 percent feel that it is only partially achieved.
- 52 percent feel that the project design is consistent in meeting project objectives while 36 percent feel the need for major changes.
- Overall performance (Bank and borrower): 79 percent have rated it as satisfactory/highly satisfactory.
- 77 percent have rated Bank performance as satisfactory/highly satisfactory.

- 52 percent feel that the State DSCs created under the project were extremely useful.
- 34 percent feel that training has been provided to less than a quarter of the staff and almost one-third feel that training had had either marginal or no impact.
- 56 percent feel that the basic safety facilities (an important component of the project) have been adequately provided for and two-thirds feel that their quality is satisfactory.
- Almost two-thirds feel that DSR Panel (created under the project for expert input related to the remedial works component) has been extremely useful and 77 percent feel that the panel adequately reflects the disciplines needed for dam safety activities.
- Almost half of the respondent feel that there was a delay in case of more than 50 percent of the dams in finalizing the design flood and 38 percent felt that the delay for some of the dam was as large as 2 years. Thirty-one percent feel that the delay was due to lack of adequate data, 27 percent due to difference of opinion on the methodology or the value of design flood between state agencies, Central Water Commission and Dam Safety Review Panel.
- Only 56 percent feel that the DSOs will be sustained with full/reduced complement of staff and functions after the project closing date.
- While there is a general agreement that funds are being provided for O&M, only 21 percent feel that such funds are provided based on dam inspection/investigation reports.
- 44 percent feel that the co-ordination between central and state agencies worked well; 45 percent though satisfied, feel there are some gray areas.
- On the question whether the states are in a position to sustain the dam safety program, the response is even.

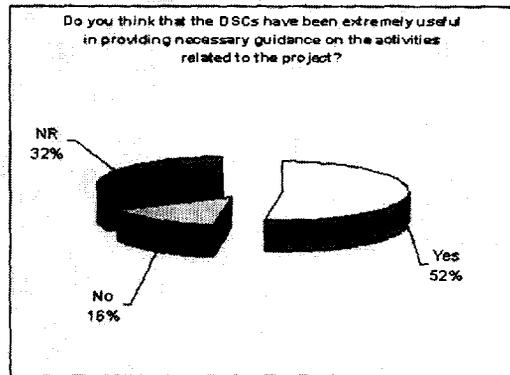
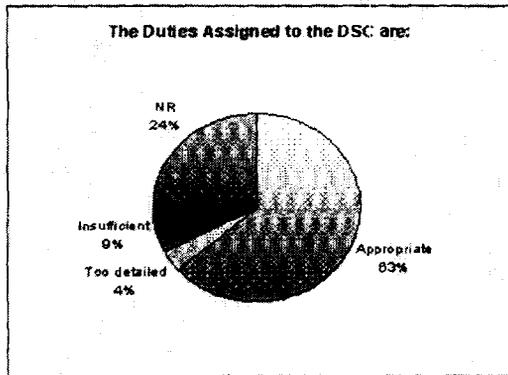
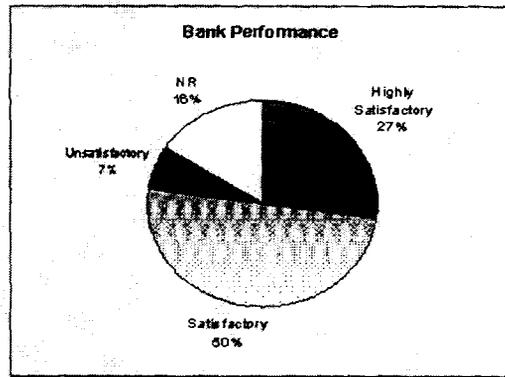
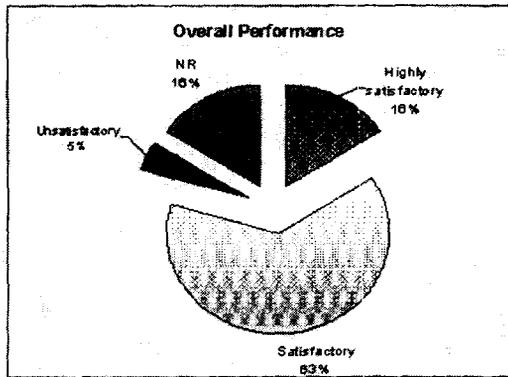
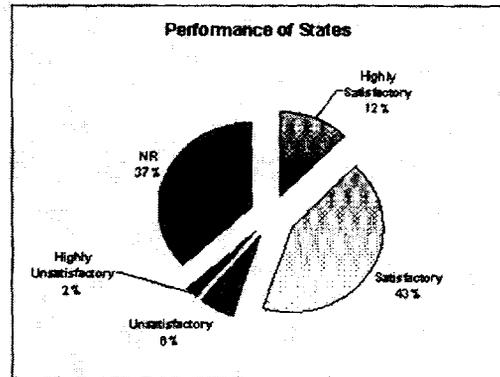
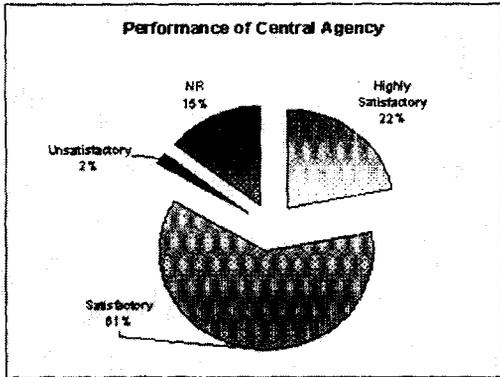
Graphical Summary

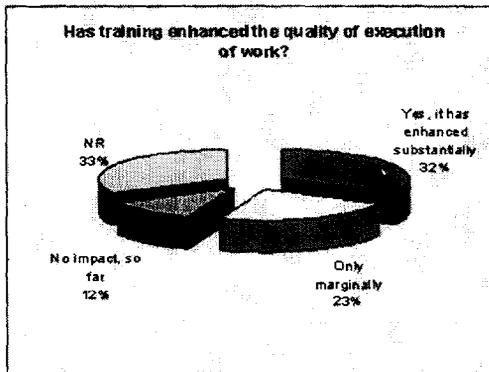
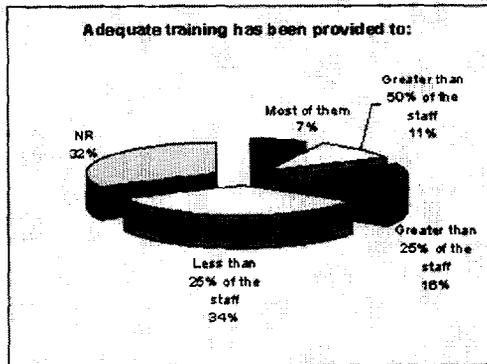
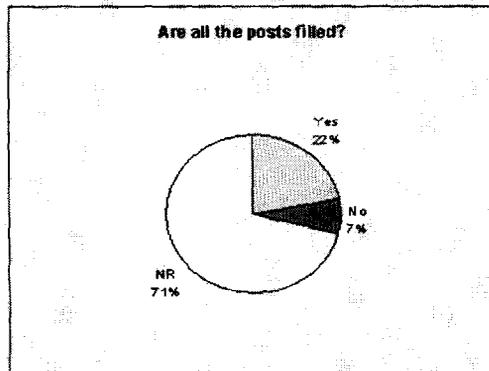
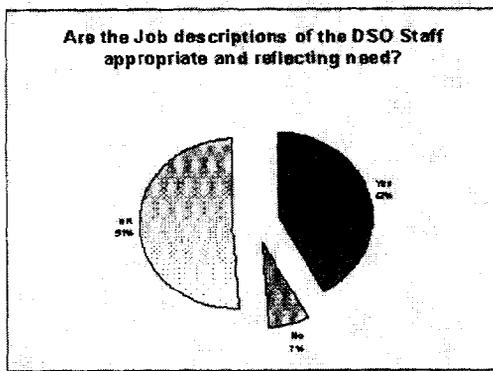
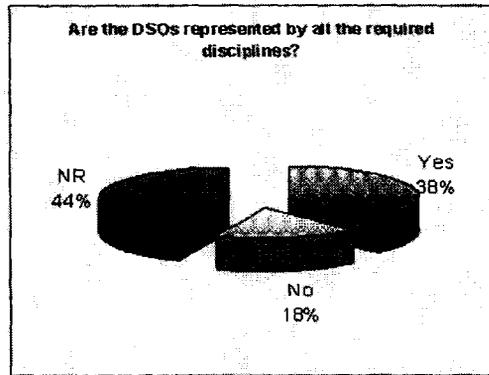
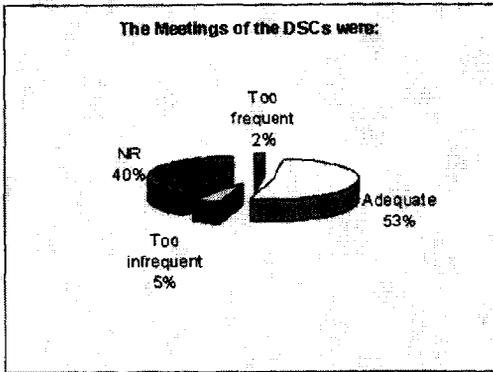
The graphical presentations of responses are as follows:

Beneficiary Survey Graphical Response Summary

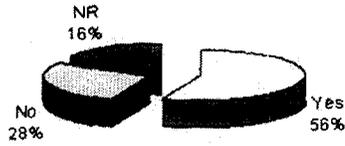


NR. Not Recorded

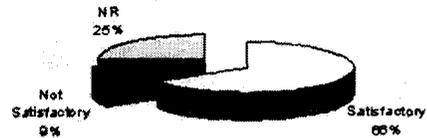




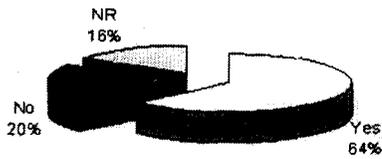
Do you think basic safety facilities as envisaged under the project have been adequately provided for all major dams that need them?



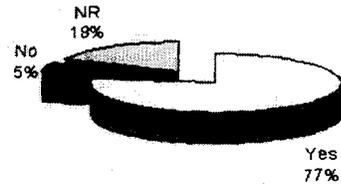
Do you think the quality of basic safety facilities provided are:



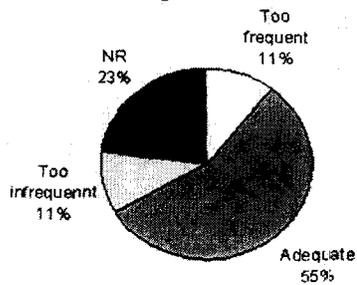
Do you think DSR Panel has been extremely useful in providing necessary advice on the remedial works to be taken up?



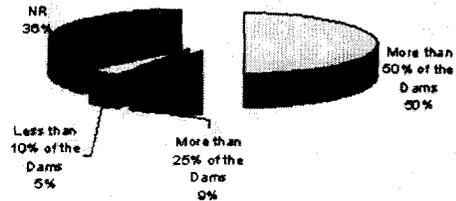
Does the DSR Panel adequately reflect the disciplines needed?

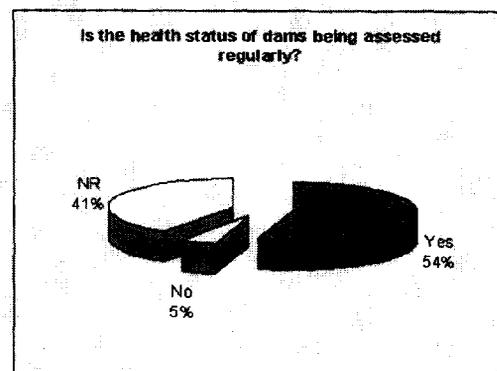
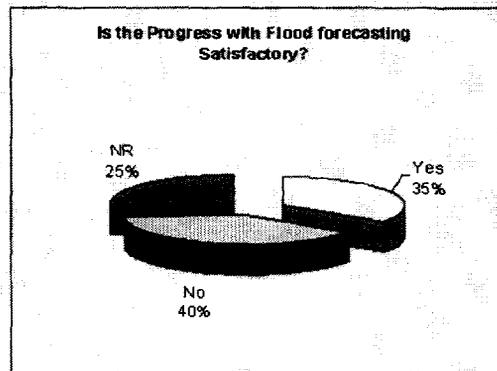
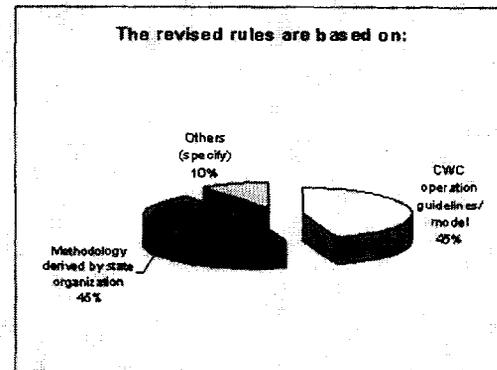
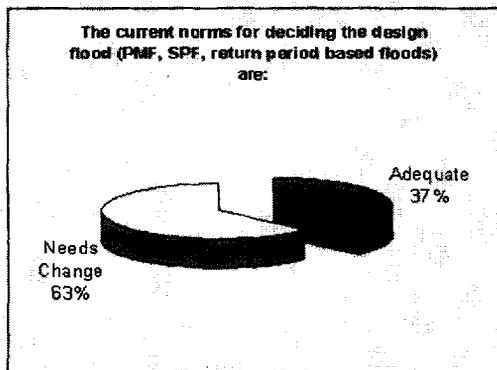
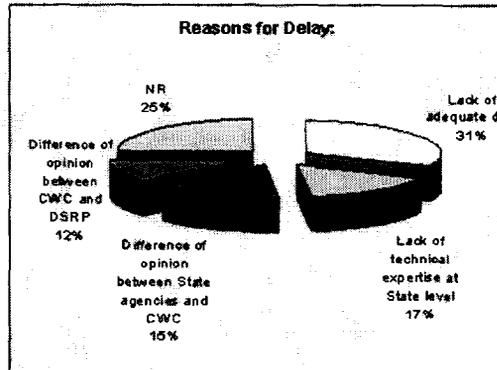
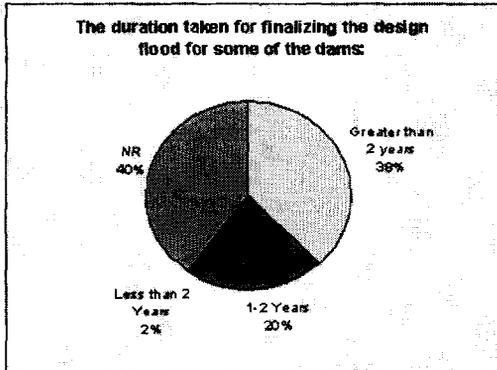


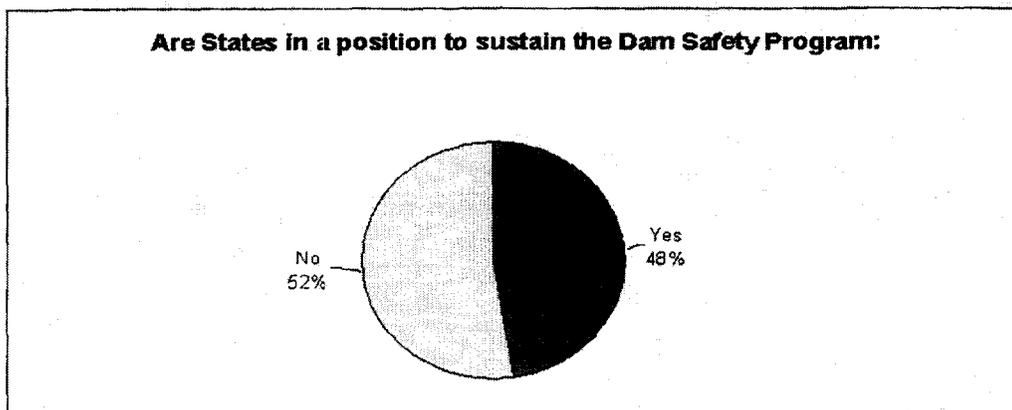
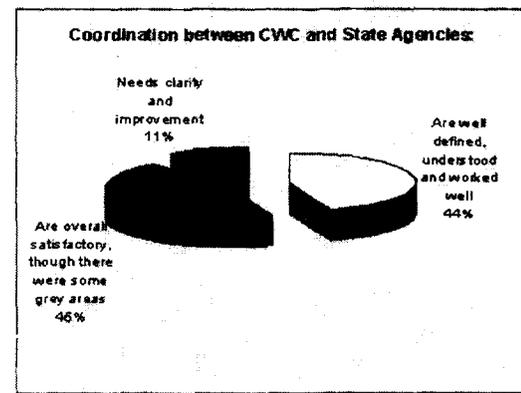
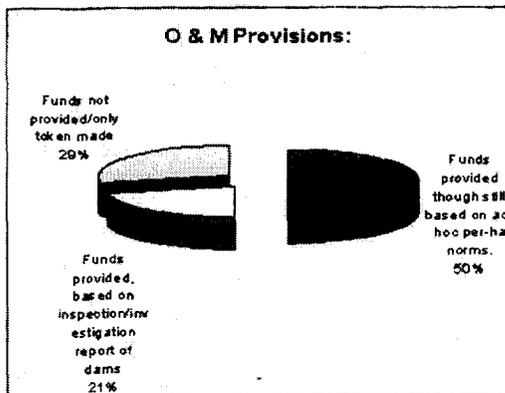
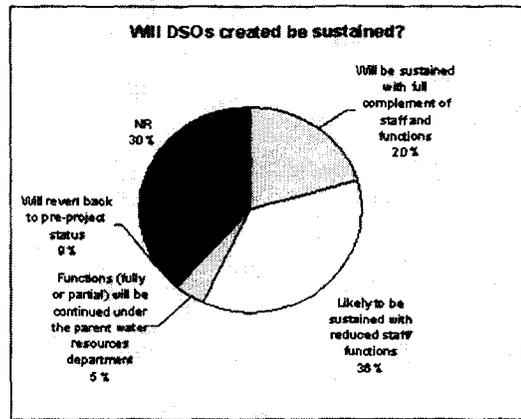
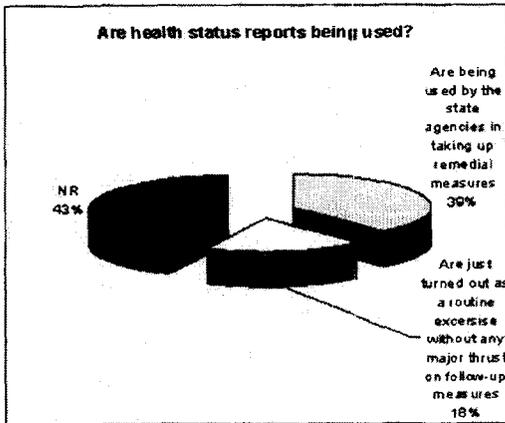
The meetings of the DSR Panel were:



Was there a substantial delay in finalizing the design flood of the dams considered for remedial measures under the project in the case of:







Extracts of some observations made by the stakeholders during the survey are given in the attachment that follows

Summary Observations from Beneficiaries

Project Objectives (Areas of concern):

Sustainability related project like dam safety project has mostly resulted in expenditure on items like deferred maintenance” Real risk alleviation needs involvement of local administrations near damage centers, who need to be formally involved.

Need to define emergency action plan for the safety of the people residing downstream from inundation.

Need for development of a comprehensive MIS with database of input parameters relevant to dam safety.

To upgrade the procedure for reservoir operation for safety assurance.

Post project analysis of safety status of dams.

Project Objectives (Achievements)

- Out of the major components of Dam Safety, the most important component , remedial measures, has been fully achieved by the states. Still some physical work remains in some projects requiring about 3.5 percent of the estimated cost. In future where remaining requirement is below say less than 10 percent (minor), full funding should be provided by the World Bank to avoid delay in completion and receipt of fruitful result early.
- The 2 primary objectives in the project i.e. strengthening of institutional framework for dam safety and upgrading of selected dams to enhance their safety status, have been achieved. Most importantly, awareness about dam safety has permeated to the rank and file of the concerned department.
- Generally cosmetic changes have taken place without commitment to main objectives.
- Institution building has not yet made very deep penetration into the system. The awareness is till limited to higher echelons of water resources administrations in the states.
- To arrive at the final remedial measure investigation and design consumed more than 60 percent of the project period. Hence full objective could not be achieved.

Project Design (Need for changes)

- Change in TOR's of safety panels.
- Safety of utility is the most important; spillway operation and regulation of flood water should be inbuilt features of the system.

- The participating agencies have an ample number of people, hence selection and placement of suitable staff needs to be done as a preproject exercise and their exhaustive training before start of real execution.
- Remote sensing the inflow stream. Automatic recorders for discharge and levels for incoming streams. Remote control gate opening.

Additional components for consideration:

- R&D efforts to use local materials and manpower for DSP.
- Sometimes major components of the Dam Project such as Hydro Power House are not included in the TOR by the state Government.
- Improving O&M schedule and ensuring advance action of instrumentation observation and evaluation by an independent scientific institution like the Indian Institute of Science.
- Dam break study and categorization of hazard of dams for safety of property and population; emergency action plan for the safety of people down stream.
- Institutional strengthening of hydraulic research stations; institutional strengthening of 'Geological Survey of India'.
- Specific provision for hands on training, to the engineering staff, in construction quality from reputed national organization like the National Council of Cement and Building materials.
- Sedimentation study; catchment area treatment.
- Should cover guidelines and recommendations for retiring some dams which are not economical to rehabilitate.
- Flood forecasting machinery; a plan for crisis management in the event of seismological activities, high floods and other anticipated failures.

Performance (Central Agency)

- All works as stipulated have been completed in a systematic manner in proper perspective.
- More involvement of CWC is necessary. It must be more than a facilitator as safety is dependent on care given at all levels; disaster should be mitigated.
- The CWC worked only as a monitoring agency, whereas we should provide guidance in implementation of the project.
- Should have been more proactive.

Performance (Bank)

- WB has been striving hard to encourage competent contractors, besides introducing the latest technology in construction and mechanization of construction process resulting in early completion of projects.
- Bank should have imposed conditions for non performance in certain components like O&M manual preparation and Phase II investigation, hydrological review and procurement.
- The Bank did not consider the constraints and submissions of the state and deleted dams from the list, where remedial works were to be done.
- As it is the first project of its kind a more intense initiative and effective monitoring/interaction in the initial years of the project could be rated as highly satisfactory.

Reasons why DSCs have not been useful:

- Committees having only "veto" power but having no responsibility to obtain positive results have been its difficulty.
- They were only monitoring the progress.
- No technical guidance

Disciplines not represented well by the DSO.

- Geotechnical;
- Hydrology;
- Socioeconomic.

DSR Panel (Utility)

- The DSRP either did not finalize the things or finalized too late, which resulted in delayed execution with more expenditure.
- The panel should have acted as facilitator group. Instead they tended to be a parallel center of authority, often leading to time-consuming conflicts.

Disciplines not adequately represented by the DSRP:

- Hydrology;
- Geotechnical.

Hydrology Review: need for revision of norms:

- Rigid adherence to PMF sometimes leads to absurd situations. More flexible decision making should be possible.
- PMF criteria existing at present particularly for the old dams needs a review at national level.

- Transposing a PMP to the dam site may not be physically possible.
- A risk-based approach could result in more rational values and reduction in rehabilitation cost.
- PMF should have relevance to the channel capacity in the downstream.

Major lessons learnt:

- Adequate staff in DSO should be provided and they should be properly trained.
- Hydrological studies should be completed on time.
- Design of remedial measures and their approval by DSRP on time.
- Local administration has to be involved in risk alleviation.
- O&M manual and data book compilation should have been completed.
- Review and monitoring of implementation schedule by CEs should be conducted in short duration to identify bottlenecks and to overcome it.
- Increased awareness of importance of Dam Safety. There is an urgent necessity to establish capability to organize systematic collection of dam behavior on a regular basis and archive information on the performance of Dams at National Level.
- Develop a public policy, as in United States, National Performance of Dam Program.
- Training course, particularly for attitude change and orientation.
- Need for methodologies, guidelines and standardization of procedures.
- Transfer of project staff and monitoring agencies should be stopped.
- The DSO should be given the responsibility of quality control also.
- Emergency preparedness is important.
- The project should have been planned after proper investigation.
- Maintenance of the project is a continuing process and needs specialized manpower as well as an independent agency to certify the health of the projects.

- Being an interstate project with a wide spread-out within each state, the existing norm of two Bank supervision missions a year, needs to be upgraded to three supervision missions a year for the follow-on DSP. This shall keep the states on alert and will expedite implementation.
- Conducting of regular progress review/ monitoring meetings biannually by chief engineers and quarterly by the secretary of the state government with due participation of contractors is of paramount importance.
- Timely flow of funds is to be ensued through legal agreement of states with the Bank.
- Time of preparatory work such as hydrological study, health of dam may be separately provided.
- Qualified and experienced engineers must be incharge of executing the project.
- Institutional development including PMP Atlas, finalization of design flood etc. should be in the first Phase; construction implementation should be part of Phase II.
- Project should be implemented in two stages, Stage I for basic facilities and investigations, finalization of design and procurement of documents. Stage II should be execution of remedial measures.
- Time frame and sequencing of activities should be defined without ambiguity.
- The capacity and the established responsibilities of implementing agencies should be evaluated beforehand.
- Hydrology, safety evaluation of dams and identification of remedial measures to be completed during the initial period of two years and only such dams included for execution of remedial measures.
- CWC to be given more authority and proactive role for effective monitoring and coordination. Also Bank supervisory mission to be more strict and effective in implementation of the project objective, especially during the initial period.
- More training in the country as well as abroad to engineers on dam safety subjects.

Important components of the follow-on project:

- Institutional strengthening;
- Basic facilities of dams;
- Remedial measures;
- Hydrological studies;
- R&D efforts in repair and improving the health of dams;
- Flood forecasting network;
- Communications upstream and downstream;
- Nationwide database for dams;
- Maintenance schedule;
- Operation manual;

- Rehabilitation of foundations of old projects;
- Hydrological information system, decision support systems for operation of projects during flood time integrating inflow forecasts and evaluation of socio-economic costing from the part of new project;
- Institutional strengthening of hydraulic research stations, institutional strengthening of 'Geological Survey of India';
- Dam safety projects should invariably include a dam utility component since investment in dam safety may be partly financed through increased utility;
- Private sector participation in sustainability;
- Preparatory Phase needed;
- Training in quality control, project management, computer networking;
- Mock training on implemented telemetry/ flood warning system for disaster management procedures;
- Improvement of nonstructural measures for dam safety/flood investigation;
- PMP study, design floods in finalization in Phase I; structural measure on dam safety should be implemented in Phase II;
- Flood forecasting system should be installed in all dams catchments and flood-warning systems upstream and downstream are to be set up;
- Post project safety assessment of the dams.

Suggestions on how to make the DSP program sustainable

- Cess/tax may be imposed on major users to sustain the activities of DSARP2.
- Prior conditions to be set for sustainability in case of next project and if possible allocate a fixed amount for the future.
- GOI to fix norms and criteria for annual plan funds for assistance.
- The dam owner should take the program seriously and mobilize resources through safe loans from internal and external financing agencies.
- When the funding of the project is finalized there should be sufficient provision to meet out maintenance for next three years so that the states get proper time to generate their own resources.
- The risk/hazard, which the dam users face, should be made public.
- Almost all of the states are experiencing financial problems. Accordingly, the states may not be in a position to sustain the dam safety program to the requisite desired level. The dam safety project being unique and first of its kind in India (and in the world), the Bank should consider a special mechanism to promote sustainability of safety program. In this context the Bank may consider a quick three- to four-year duration "Dam safety Sustainability Project" amounting to, say, \$15-2 million to cover the cost of maintaining DSRPs, incremental staff, preparation of POMs of dams, documentation of history of dams, left over basic facilities, and execution of any remedial measures associated with critical distress observed recently including the dams subjected to severe onslaught cyclone in Orissa.
- The Bank should provide funding keeping in view prioritization of remedial measures and importance of the Dam. In above, to have uniform policy, central monitoring body should be set up to liaise with the Bank, MOWR and state government.
- During implementation of remedial measures services of DSRP consultancy agencies be continued to fine tune the recommendations made in the course of construction. Entrusting quality assurance of remedial measures to the consultancy agency would also go a long way in adequate rehabilitation of aging dams.
- More than one state can join hands to have a common dam safety organization.

- A roving DSO at the regional or national levels can be created.
- Incentive mechanism required for retaining the trained/willing/qualified personnel.
- There should be dam safety set-up for each dam at appropriate level including public representation.
- A program be launched for public awareness to dam safety; part public funding through rural development organizations; soft loan from lending agencies.
- Continuity of staff in design offices and dam and safety offices.
- A legalization and legal power is needed to ensure compilation of safety principles.
- Water rates should be raised commensurate with the M&R cost and major repair cost.
- Awareness should be created among the end users to prepare them to contribute adequately for the cost of remedial measures.
- The state or central governments should subsidize water resource departments, or else they should be brought under the purview of the government-owned corporations/boards to generate their funds.
- Make special budget provision for dam safety aspect; avail funding for Phase II DSARP with 9th Plan.

Perception of the benefits of the project as a stakeholder:

- Reduced risk cost with the rehabilitated dams.
- Improved awareness of dam safety concept in the Indian water resources sector.
- Improved the technical capacity of state/CWC staff in handling dam safety related issues.
- Reduced sustainability with the number of lives at risk downstream of the dams.
- Improved the quality of remedial measures proposed due to interaction of CWC/states/DSRP/consultants/contractors in an intensive way.
- Improved the benefits to the populace living downstream.

Annex 9. Stakeholder Workshop Results

Objectives:

The aim of the workshop was to share the experience of a diverse set of stakeholders, consisting of officials from the government of India and state governments, consultants, contractors, non-governmental groups, experts, academics, legislators and farmer representatives on the design, implementation and outcome of the dam safety project.

This was expected to lead to:

- greater understanding of implementation issues of the project;
- assessment of the achievement of the project's objectives;
- identification of co-ordination issues relevant to project design and implementation; and
- lessons learned for use in case of a follow-on project.

Participants:

There were 78 participants (see Appendix 1) in total representing the MOWR, DEA, CWC, engineers from the implementing states of Orissa, Tamil Nadu, Rajasthan, and Madhya Pradesh; National Planning Commission, Dam Safety Review Panel chairmen/members, academia, Central Board of Irrigation and Power (representing the Indian National Committee on Large Dams), International Commission on Irrigation and Drainage, representatives from primary beneficiaries (farmer representatives, ex-members of the legislative assembly); contractors and consultants. The break up is as below:

GOI (MOWR, DEA, and Planning Commission):	5
Implementing agencies:	
• CWC	10
• States	18
NGO group:	
• Dam Safety Review Panel members	12
• Consultants	4
• Academia/experts	6
• Contractors	9
• Farmer representative	3
• Political group (ex-MLA)	1
• FAO-CP	3
• Bank	7

Deliberations Summary:

In the inaugural session (see Annex 9), the key note address was delivered by Mr. Z. Hasan, Secretary, Union Ministry of Water Resources, who underlined the importance of such stand alone dam safety project for a country like India which has around 4,000 large dams. He also indicated the current exercise on in MOWR for a follow on project. Mr. A. Bhandari (Operations Advisor, World Bank) presented the salient features of the intensive learning ICR and the objective of the stakeholder's workshop. Mr. Rajagopal (Water Resource

Specialist) dwelt on the Bank policies related to dam safety.

In the first technical session chaired by Mr. Hasan, all the implementing agencies (CWC and the four participating states of Rajasthan, MP, Orissa and Tamil Nadu) presented the details of implementation status of the project in their states, achievement and lessons learned. Through scanned photographs the implementing agencies presented dam by dam the pre and post dam safety project status related to various components of the project. This was followed by a presentation by Mr. R. Paterson (the ICR mission leader from FAO-CP) on the preliminary findings of the ICR mission. The **implementation issues; concept/design issues and outcome/benefit issues** were discussed in three parallel group sessions.

The recommendations of these groups were presented and discussed in a plenary on November 12, 1999, and final lessons learned/recommendations discussed and summarized below. Mr. Alessandro Palmeiri (Senior Dam Specialist, RDV) presented international perspective on dam safety especially the Bank experience and a simple methodology to carry out a risk analysis to determine and prioritize candidate dams. Mr. David Plinston (consultant hydrologist, FAO/CP) presented methodology for arriving at simple reservoir operation strategy during floods which can be easily followed by a gate operator of the dams in India. A number of speakers (farmer representatives, ex-MLA, contractors, consultants, DSR Panel members shared their perception of the project in technical session V. The concluding session was chaired by Mr. Nawalawalah, Advisor (Irrigation), Planning Commission. He dwelt in detail on the maintenance issue related to dams, especially provision of inadequate funding for the works component of the repair/maintenance through revenue budget. He suggested funding part of such expenditure through plan funding (capital expenditure). The Chairman, Central Water Commission, Mr. A.D. Mohile briefly outlined the possible follow-on project. Mr. E.V. Jagannathan (Water Resources Engineer), World Bank, presented the preliminary summary statistics of beneficiary responses on the survey carried out.

Workshop Recommendations (as presented by Mr. Paterson in the concluding Session)

- It is necessary to define the benefits of project works. This should be done with the participation of beneficiaries and those affected by the project, both upstream and downstream of the dam.
- Dams selected for remedial works and provision of basic facilities should be prioritized according to the benefits and costs.
- Clear terms of reference are needed in the project documents for all parties involved with the selection, investigation and design of project works, including consultants, Dam Safety Review Panels (DSRP), CWC and others.
- Dam Safety Review Panels are a requirement of the World Bank for all dams associated with Bank projects. They should be advisory only and their TOR should clearly indicate time allowed for their operations. Guidance on the recruitment of DSRP was provided in a paper, by Hoek and Imrie, distributed at the workshop.
- Private consultants have their role. Their TOR should be time-bound. A possible way to improve performance would be to give consultants contracts with short duration: if they do not perform satisfactorily, their contract would not be renewed.
- CWC should not act as hydrology consultants when they have authority to approve design floods. CWC's other main purposes as far as the project is concerned should be the production and dissemination of guidelines and training.
- More training was required than was provided under the project, particularly in the fields of Bank procedures;
 - Construction quality control;
 - Contract management;
 - Dam instrumentation.
 - Wherever practicable training should be given on the job.
 - Continuity of personnel would greatly improve implementation efficiency and dam safety.
 - Availability of funds for construction was a problem during implementation. The Bank advances 25 percent of the year's budget but this does not reach the implementing agencies. It was suggested that assurances should be sought from the Borrower in the legal agreements to ensure that implementing

agencies have funds available at the start of the financial year, particularly when this coincides with the construction season.

- Many reservoirs with gated spillways do not have clear detailed operating rules. A straightforward procedure for deriving such operating rules was described to the workshop participants. This should be adopted for all reservoirs with gated spillways. The responsible Chief Engineers should be instructed to ensure that this is done.
- Emergency action plans are required for all reservoirs. They should be made with public participation and should be published. A paper by United States Bureau of Reclamation on emergency preparedness plans was distributed to all participants at the workshop.
- There is a need for legislation to ensure that dams are safe.

Summaries of technical group discussions

A. Group I - Implementation Issues

The meeting of Group I was attended by 16 experts representing DSRP members, states, the Bank, and contractors. Mr. R.K. Malhotra, an eminent construction expert, chaired this group session. The group made the following recommendations (presented by Mr. Malhotra in the workshop):

Recommendations:

- Training in quality control/quality assurance in construction to engineering staff and contractors' staff in reputed organization like NCB.
- Training on Bank procurement procedures/disbursement to all projects related staff.
- Institutional strengthening of state nucleus cells (in design organization) on construction equipment planning and management, as well as instrumentation.
- Any follow-up DSP should consist of two 2 phases--Phase I: institutional strengthening and basic safety facilities; and Phase II: remedial measures of those dams, which are in full state readiness.
- Time bound plans for all activities should be incorporated in project implementation schedules for all parties concerned (owner, DSRP, consultants, approval agencies, etc.), making use of CPM/PERT facilities.
- Construction/implementation progress review and monitoring meetings should be held bi-monthly with concerned chief engineers/additional chief engineers, with participation of concerned contractors.
- For meaningful coordination of multi-disciplinary agencies (CWC, DSRP, GSI, consultants, EIC, CE's) appoint CE (DSO) as project manager cum coordinator.
- Allotted budget and timely release of funds must be ensured in the form of legal agreement.
- Once project scope and provisions are agreed and defined in PAD (viz. vehicles, equipment, communication equipment, buildings etc.) no more clearance on these items should be insisted upon by finance.

Group II - Concept and Design Issues

Group II's meeting was attended by 24 experts, representing DSRP (members, experts, consultants, CWC, planning commission, states, Bank staff, FAO). Dr. K.C. Thomas chaired the session. Dr. S.M. Seth was the reporter. Dr. Palmieri of Bank was the facilitator. There was unanimity of agreement on the objectives of the scheme and its continuation to cover more dams and more states. However, there could be changes in the terms of reference and modalities of implementation. Views were expressed by members on various issues, particularly those having emphasis on recently completed project. These included:

- Need for external funding support for dam safety related activities.
- Need for redefining the role of DSRP to make it more broad based and proactive, including the role to suggest suitable remedial measures.
- In any dam project, there is element of Risk involved and design parameters should be based on both risk as well as economic aspects with due consideration of local site specific conditions.
- Thorough review of approaches and procedures (deterministic/statistical) for hydrological analysis is necessary to decide design flood with a view to keep it realistic with due consideration of reliability, risk, uncertainty, and safety. These could also be discussed at some International Seminar.
- Desirability of CWC to have an arbiter's role only rather than both as consultant and arbiter.
- Suitable mechanism needs to be introduced for interaction of different DSRPs, DSRPs and CWC, and DSRPs and Bank at appropriate stages of the project.
- There is need for laying down suitable procedures/guidelines for deciding earthquake parameters.
- The need for maintaining continuity of specialized personnel in design offices, DSOs, and project sites operational roles was emphasized. The need for suitable incentives was also mentioned.
- The small dams require special concern, in view of likelihood of extreme flood events of flashy nature. For small dams and dams in remote locations, ungated spillways should be preferred keeping in view flash floods and likely human errors.
- There is need for reasonable network of ORG's and SRRG'S in each dam catchment for proper estimation of design flood using historical data.
- The objective of Dam Safety Project should be safety of life and property with due consideration of local site specific/country specific factors. The remedial measures would include structural as well as nonstructural measures.
- The role of state organizations vis-à-vis DSRP also needs to be properly defined in order to achieve project objectives in a smooth time bound manner as per schedule.
- State DSOs should be properly structured with clearly defined roles of dam safety evaluation, regular monitoring, proper instrumentation, proper maintenance etc. with suitable review boards comprising of internal or internal/external experts/officers.
- It is desirable to have for all dams/completed projects appropriately compiled historical information in the form of data books, reports, maps, drawings, quality control, instrumentation etc. These should form important information for dam safety review.
- The role of CWC should be more proactive with suitable mechanism for review, interaction with DSRPs and states. All publications, guidelines etc., prepared by CWC, should be distributed to all concerned including DSRP members.
- Model emergency preparedness plans should be prepared as a guide for use by states for preparing similar plans for specific dams/projects.
- Guidelines should be prepared for operation of various types/sizes of dams/reservoirs, including real time operation.
- Before taking up the main activities of project with new states/new dams in existing states under the project, appropriate preparatory phase is necessary with DSRP involvement to include

inspection, compilation of data/information, identification of dams under distress, prioritization of dams, deciding hydrologic design parameters etc. The project duration, therefore needs to be decided accordingly to provide time for preparatory phase.

- There is need for establishing suitable criteria for evaluating efficacy of remedial measures and their periodical monitoring.
- Suitable laws should be enacted at national level/state level for dam safety related issues, in order to ensure desired objectives of safety.
- It can be concluded that all participants in Group II favored the need for taking up dam safety project to cover more dams/states with World Bank assistance. The need for: (a) proper structuring of dam safety organizations in states; (b) consideration of design flood estimation issue in a rational manner keeping in view risk, uncertainty, safety & economy; (c) properly defining role of DSRPs; (d) interaction mechanism of all concerned; and (e) provision of preparatory phase of project were emphasized.

Group III - Outcome/Benefit Related Issues

- The beneficiaries to be informed about the need of dam safety so that benefits of a dam reach them without any hindrance. The beneficiaries (especially farmers) want proper attention to stop degradation of catchment and proper maintenance of canals for round the year service from the dam.
- There should be involvement of beneficiaries in decision-making and sharing of costs for dam safety so that dam safety is cost effective. This will help in reducing the cost for rehabilitation of dams for safety and will also be useful in accountability of the dam managers.
- Flood forecasting to be an integral part of the dam safety program.
- There is a need to build up database for dam safety so that all information about the safety of dam and historical data about the dam are available at dam site as well as in the DSOs.
- A need was felt to have a built in mechanism under dam safety for reassessment of the original assumptions and risks so that steps can be taken to remedy the deficiencies for safety of dam. The O&M plans need to be revised at least once in five years based on the recommendations made as a result of reassessment of safety of dam.
- There should be an immediate safety evaluation of all the dams in a state. The safety evaluation should include the hydrology review, seismic revisions, dam break analysis, preparation of inundation maps and emergency action plans, etc. A start for risk analysis of the safety of dams can also be made in a limited way. This will also help in prioritization and in finalizing the remedial measures to be undertaken for rehabilitation of dams.
- There is an urgent need to have a legislation to make the owners of dams aware of their obligations towards dam safety and the society.
- It was felt that a provision of basic dam safety facilities should cover all the dams in the state. states/owners should undertake a review of such facilities at their dams and immediately take action to provide them at all dams.
- The group unanimously recommended formulation of a Dam Safety II Project, which can be divided into two parts--first dealing with safety evaluation; and the second may be kept for execution of remedial measures to rehabilitate dams under distress.

Annex 10. Borrower's PCR

CENTRAL WATER COMMISSION DAM SAFETY MONITORING DIRECTORATE

INDIA – DAM SAFETY PROJECT [2241-IN] *PROJECT COMPLETION REPORT*

Dam Safety Assurance and Rehabilitation Project (DSARP) was taken up for implementation with the World Bank assistance in 1991. The total estimated base cost of the Project was US \$172 million out of which the States' share was US \$160 million and that of Centre US \$12 million. The total Project cost, including contingencies, was US \$197 million i.e. Rs.4559.80 million as detailed out in the Staff Appraisal Report (SAR) of the World Bank. The disbursements were projected over a period of 6 years commencing from 1991-92 and the credit was to close by September 1997. However, the Central as well as the State Governments requested the World Bank to extend the Project period by two years, i.e. upto September 1999. The World Bank accepted the request and extended the project twice on yearly basis. The final restructured cost of the project is US \$ 92.973 million, i.e. Rs.4231.83 million. Apart from CWC at the Centre, the other beneficiary States under the project include Madhya Pradesh, Orissa, Rajasthan & Tamil Nadu. The project ended on 30.9.99.

As desired by the World Bank vide letters dated 5.5.99 and 16.7.99, this Project Completion Report (PCR) has been prepared on the guidelines contained in Attachment I of the letter dated 5.5.99. The Report has, therefore, been divided into four parts, i.e. (a) Project Design; (b) Project Appraisal; (c) Project Implementation; and (d) Project Results.

The main lessons learnt from the implementation experience and arising from the above analysis are summarized at the end of the Report. The Report is supplemented by six tables, as per World Bank letter viz. key performance indicators, key indicators for project operation, financial progress, studies included in the project, project financing (item-wise) and project financing (total by agency). Copies of the World Bank letters referred to above are enclosed as Annex I & II. The status report of implementation of the project as on 31.8.99 is enclosed as Annex III to the Report.. In addition to these, copies of ICRs as received from the participating States, i.e. Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu are also enclosed with this Report.

PROJECT DESIGN

Two primary objectives of the Dam Safety Assurance & Rehabilitation Project as stipulated in the Staff Appraisal Report (SAR) of the project are:

- (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.*

The Project objectives have been chosen appropriately and are very much relevant to the project. These have been very useful in strengthening the dam safety activities in India. The scope of the investments

stipulated in the SAR, an amount of Rs.214.6 million (US \$11.9 million), i.e. 6.9% of the base cost was proposed towards Institutional Strengthening of the Dam Safety Organizations (DSO) at the Centre and participating States. For modernisation of flood forecasting network, an amount of Rs.161 million (US \$ 8.9 million) i.e. 5.2% of the base cost was envisaged. Provision for upgrading the basic dam safety facilities at identified dams in the participating States was Rs.438.8 million (US \$22.8 million), i.e. 14.2% of the base cost of the project. A provision of Rs.2283.9 million (US \$126.9 million) was kept for execution of remedial works for rehabilitation of dams. This is 73.7% of the total base cost of the project. Physical and price contingencies were in addition to the above base cost.

The following observations are made on the size and scope of investments stipulated in the SAR:

1. Being the first Dam Safety Project not only in India but also to be assisted by the World Bank and uniqueness of the project, the period of implementation of the project should have been kept between 8 & 10 years, specially when it was known that:
 - (a) hydrology of a number of dams has not been completed;
 - (b) identification of remedial measures and prioritization of dams to be taken up for rehabilitation had not been done for most of the dams included in the project at the start of the project; and
 - (c) when it was stipulated (in the SAR itself) that more dams can be included during implementation of the project for taking up rehabilitation. Alternatively it could have been stipulated that only those additional dams will be included for rehabilitation on which identification of remedial works are finalised within two years of the start of the project.
2. More provision was required for Institutional strengthening. This is substantiated by the fact that the average expenditure on the institutional strengthening at the end of the project is of the order of about 122% of SAR provisions whereas it exceeded by about 200% of the SAR provision in case one of the participating States, i.e. Rajasthan.
3. Extensive training to the staff of the implementing agencies directly associated with the project, about the procurement procedures and other important rules/regulations of the World Bank should have been proposed at the start of the project.
4. A total of 10 man-months for training of Indian engineers and holding of 10 workshops in India were proposed in SAR. In addition, 98 man-months for trainings and study tours abroad were provided in SAR. For a project of this type where dam safety is in the initial stages of development in India, the provisions have been very useful and have helped Indian Engineers to get more exposures in dam safety activities in developed countries and adopt them in India as well.
5. A mechanism to make the implementing agencies agree for redeployment of the staff as per the provisions in SAR should have been devised so as to achieve the desired results, i.e. posting/redeployment of the staff in the DSOs within one year of the start of the project. This would have definitely accelerated the implementation of the project from the beginning itself. Assurance should have been taken from the implementing agencies not to transfer the key personnel associated with the project during the project period. Further a stringent provision for not fulfilling the SAR assurance given by implementing agencies regarding making the SDSO staff a part of permanent establishment by August 31,1996 should have been stipulated.

6. Similarly it is felt that more weightage could have been given to the provision for basic dam safety facilities at more dams in the SAR. A provision of maximum 25% of the cost of the project would have been adequate for this component of the project. This inadequacy could have been corrected during the mid-term review by increasing the dams for provision of basic dam safety facilities.

7. The DSR Panels should have been flexible in composition with a provision that in case of any rigid stand taken by DSRPs with regard to identification and finalisation of remedial works for rehabilitation of dams, the matter could be referred to CWC for final decision to be taken within a fixed time frame.

8. The delay in taking up the implementation of modernisation of flood forecasting work could have been accelerated and extended to more basins, dams and reservoirs, if the provisions on this component had been firmed up and clearly spelt out at the Appraisal Stage itself.

EFFECT ON GOVERNMENT INSTITUTIONS

1. By implementation of this project the maximum gain to the Government institutions has been that awareness of Dam Safety has reached the highest level of the Govt. and the implementing agencies.

2. Being the first project of its type the sailing was not smooth during the initial stages of implementation of the project. Now the implementing agencies have been equipped with a very good infrastructure for a good Dam Safety Organisation with trained staff who are now geared for taking up further dam safety activities in their respective jurisdictions.

3. It has been possible to install and operate the latest state of the art flood forecasting systems for getting information on real time basis about the hydrological and hydro-meteorological data at the Control centres to formulate forecasts with greater efficiency and accuracy in the Mahanadi and Chambal basins. This has contributed considerably enhancing the safety of dams in these two basins. This may lead to a new change in the approach of flood forecasting in the country by extending this system to all the river basins in the country.

PROJECT APPRAISAL

There was no change with regard to objectives spelt out in the Staff Appraisal Report (SAR) during the implementation of the project. However, the following observations are made:

1. During the course of implementation of the project, 22 dams were added for rehabilitation through remedial works in addition to 33 dams already identified for this purpose at the time of appraisal. The identification of the remedial measures even for the originally included 33 dams were not completed at the start of the project which resulted in considerable delay. The inclusion of new dams should have been considered only after complete identification of remedial measures in the originally identified dams and, as already commented in the Chapter on "Project Design", the inclusion of new dams should have been restricted upto 2 years from the start of the project.

2. During the first restructuring of the project at the end of the project period i.e. after 6 years, 87 dams were added to the 98 dams already included for provision of basic dam safety facilities. This exercise could have been done earlier, may be during the mid-term appraisal of the project, so that adequate time could have been made available for receiving and enhancing basic dam safety facilities. It is very encouraging to observe that most of the dams included during the first restructuring i.e. just two years back have been upgraded by provisions of these basic dam safety facilities.
3. There was increase in the allocation of funds for the Institutional strengthening during the first and second restructuring of the project and these seem to be quite appropriate and adequate. During the first restructuring of the project in September 1997, funding of 15 dams meant for rehabilitation through remedial works were dropped by the Bank due to slow construction activity on these dams. It is felt that such an action of dropping dams could have been deferred by setting suitable targets, to the second restructuring i.e. from Oct. 1998. This could have given opportunity to the implementing agencies to accelerate the execution of remedial works on these dams and would have also helped in rehabilitation of more dams under the project.
4. The exclusion of the State of Tamil Nadu from funding by the World Bank during the second restructuring could have been avoided for the simple reason that remedial measures on only 2 dams were being executed at the time of exclusion of Tamil Nadu component of the project.
5. The exclusion of telemetry system as proposed by Government of Orissa should have in fact been deleted much earlier due to the fact that CWC was also providing more or less the same type of telemetry system on the same river basin i.e. Mahanadi basin with an identical objective i.e. for real time flood forecasting to the Hirakud reservoir.
6. The restructuring and extension of the project after completion of its stipulated period of 6 years, initially by one year instead of two years was a good decision and was instrumental in accelerating the pace of implementation of the project and better utilisation of the Bank credit which at the close of the credit date is of the order of almost 100% of the second restructured project cost.

PROJECT IMPLEMENTATION

The implementation has been quite smooth and orderly, however, following points are brought out:

1. In general, IDA performance in supporting and supervising the project has been quite helpful and positive. However, hardships have been experienced by most of the participating States regarding flow of funds during the implementation of the project and it is felt that progress would have been faster if timely flow of funds to the executing agencies could have been ensured throughout the year, specially during the first quarter of the financial years.
2. Though there were slippages at the initial stage of the project the final progress achieved at the closing of the project is quite satisfactory. The initial slippages were due to the fact that first, the nature of the project was unique and it was the first such project in India. The State and Central institutional set up was not conversant with technical and financial procedures. Second, due to delay in finalising design floods mainly due to non-availability of hydrological & meteorological data, more time was consumed than it was estimated at the time of preparing SAR. Third, the procedure laid down in the SAR to approve a project for execution has inbuilt time lag between the preparation of the proposal for remedial works and its finalisation by the Dam Safety Review Panels. Some of the participating States have expressed that the

requirement of approval of all remedial works by the Dam Safety Review Panel and vetting of all hydrological reviews by CWC was time consuming. Sometimes delay has been noticed because the consultants could not complete their job on time.

3. The implementation agencies had been complaining of delay in approval of the remedial works to be taken up for rehabilitation of dams by Dam Safety Review Panels but they did not resort to the provisions in the Staff Appraisal Report to constitute more than one panel in a State.

4. Monitoring agencies in the participating States could have been strengthened and made more effective in giving momentum to the execution of remedial works instead of collecting data and compiling them for report purpose. Monitoring of the project should have been carried out at the highest level and identified at the time of appraisal itself.

5. The performance of the implementing agencies and the support and supervision given by the World Bank during the extended period has been very remarkable. After restructuring the project, the performance/expenditure incurred by the implementing agencies, which was only 44% (of the final restructured cost) at the end of the project period of 6 year, increased to 56% during the extended period of 2 years. This corroborates the feeling that the project period should have been more than 6 years and being a project, first of its kind, it should have been supervised and monitored more frequently, in the initial stages.

6. There was delay in the formulation of training programmes for Indian engineers abroad which was not stressed upon by the Supervisory Missions of the Bank during their review including the mid term review taken up by the Bank. However, trainings and workshops in India, for which most of the faculty was provided by CWC, were evenly distributed during the project period. It is quite pertinent to bring out that most of the training programmes abroad were formulated and executed during the extended period of the project.

7. There have been instances when complaints have been made to the World Bank regarding handling of procurement issues and refusal by World Bank for award. However in case the Governments at the Centre or in the participating States, having given due consideration and investigation to such complaints, have still recommended award of work, the World Bank should have honoured the recommendations of the implementing agencies. It is felt that there is a need to appreciate the stand taken by the implementing agencies on such cases of complaints and the World Bank should not entertain them which cause delay in the implementation of the project or may lead to non procurement.

PROJECT RESULTS

Dam safety programme will help in deriving optimum benefits from various dams covered under the project.

1. Institutional set up of Dam Safety Organisation at the Centre as well as in the four participating States have been strengthened through training of officers, installation of modern equipments etc. This will go a long way in handling future dam safety projects. Awareness with respect to the safety aspect of the dam has been created in the participating States in particular and through out the country in general.

2. Formulation and use of a number of Guidelines on Dam Safety and PMP Atlases by the

implementing agencies and dam owners has been one of the most significant and unique achievement of the project. With the use of PMP Atlases, the uniformity in methodology/ approach for the estimates of appropriate precipitation values in the various region has been achieved and this will save lot of time in collection of relevant data for taking up review of flood hydrology. The guidelines prepared on “ Management of dam safety risks” under the project has been another significant achievement. With these guidelines based on the latest concept of risk analysis in Dam Safety, India has become one such country, in addition to a few developed countries of the world, to initiate action in this regard.

3. Basic dam safety facilities like providing access roads, back up power, instrumentation, installation of communication system, stockpiling of emergency material, etc., have been provided at 180 dams in the 4 States out of total of 185 dams (Details in Annex III of Tables & Annexures). The upgrading of physical features around these dams has enhanced the safety of the dams, including improved management of the dams during extreme and emergency situations. This has also resulted in improved inspection and monitoring system of the dams.

4. 40 dams (out of 55 dams proposed) where remedial measures have been completed under this project have come up to the desired safety level, reducing the risk and adverse environmental impact on the property and people living downstream. (Details in Annex III of Tables & Annexures). Thus likely loss of reservoir capacities have been restored to provide for assured irrigation/water supply/power generation which in turn will contribute to the economic development of the respective regions in the country. This has also enhanced the confidence of the owners for safety of dams. It is felt that the safety standards achieved by this project will be sustained by proper operation, maintenance and surveillance of dams by the owners for which the most essential input is provision of funds for this purpose. The State Governments are committed to sustain and strengthen this achievement of the project by provision of adequate funds for the purpose.

5. There has been practically no negative impact on the environment in the vicinity of the dams where remedial works were undertaken or access roads were constructed. However, no studies were undertaken by the participating States to study negative effect, if any. The implementation of this project has definitely created a positive environmental impact by allowing better regulation of large floods to reduce the peak flows downstream and reduce damages.

MAIN LESSONS LEARNT FROM THE IMPLEMENTATION EXPERIENCE

- I. Adequate institutional support in all fields of specialization is a must for successful implementation of the project. Provision of all infrastructure facilities to the DSOs and field units implementing the project should have been provided within the first year of start of the project and improved upon subsequently as and when required.
- II. Training of project implementation officials in procurement procedures of the World Bank is necessary for speedy implementation of the project. Specialised technical programmes abroad undertaken during the implementation of the project have given exposure to Indian engineers for better appreciation of the dam safety in the developed countries and its adoption in India.
- III. Proper and realistic Hydrology Studies on dams should be completed well in advance.

- IV. Adequate funding is an important and necessary requirement. For speedy implementation adequate and timely flow of funds is a must for early completion of works. Flow of funds to be streamlined by the implementing agencies round the year especially during the beginning of the financial year.
- V. In case of any rigid stand by DSR Panels, regarding identification of remedial measures, the issues could be referred to CWC for final decision in time-bound period. There should be more than one DSR Panel for fast decisions on identification and execution of remedial works.
- VI. Better framing of the contractual documents could have been done to avoid ambiguities. Estimation of quantities for major works for execution are required to be as accurate as possible and should be approved by panel of experts, to avoid extra items and disputes during the implementation.
- VII. Strict implementation of procurement schedules should be ensured at the highest level.
- VIII. Mechanism should be evolved for regular review of construction schedule by project Chief Engineers, identify the bottlenecks and remove them expeditiously.
- IX. Officers and staff responsible for implementing the project should be educated and trained about the components and the time schedule for completion of the project. Transfer of project staff and monitoring agencies should be avoided.
- X. PERT, CPM charts and implementation schedules to be prepared and reviewed at the highest level at regular intervals to make up the slippages, if any, during the implementation of the project.

ACTION PLAN FOR FUTURE OPERATION

The work of review of design flood has been completed only for some selected large dams in the four States. It is very essential that all the large dams in respective States undergo periodic reviews for dam safety. As per the decision of NCDS all large dams with storage of more than 50 million acre ft. shall have their design flood reviewed every 10 years. This gigantic task is yet to be achieved, due to lack of trained manpower and other resources. Keeping the above in consideration, it has been planned to undertake the following works by the Hydrology Unit of CWC in association with State Hydrology Units, during the 2nd phase of Dam Safety Project:

1. Vetting of design flood reviews including technical advice/consultancy for design flood review of the remaining large dams in the participating and other interested States.
2. Preparation of PMP Atlas for remaining basins in India.
3. Conversion of PMP Atlases already prepared into GIS package and their dissemination through national network.
4. Strengthening of computerization in Hydrology Units in CWC and the participating States.
5. Training of CWC/State personnel in the state-of-the-art tools for hydrological studies.

The Dam safety Organization in CWC will continue providing assistance to the State Dam Safety Organisations in all dam safety aspects through: