PROJECT PERFORMANCE ASSESSMENT REPORT

INDIA

DAM SAFETY PROJECT
(CREDIT 2241-IND); (LOAN 3325-IND)

June 16, 2009

Sector Evaluation Division
Independent Evaluation Group (World Bank)
Currency Equivalents (annual averages)

Currency Unit = Indian Rupee (INR)

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Abbreviations and Acronyms

CWC  Central Water Commission
DCA  Development Credit Agreement
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)
EAP  Emergency Action Plan
FRL  Full Reservoir Level
GOI  Government of India
HO   Hydrology Organization of CWC
ICOLD International Committee on Large Dams
ICR  Implementation Completion Report
MOWR Ministry of Water Resources
MTR  Mid-term Review
MWL  Maximum Water Level
O&M  Operation and Maintenance
PMP  Probable Maximum Precipitation
SAR  Staff Appraisal Report

Indian Fiscal Year

April 1 – March 31

Director-General, Evaluation : Mr. Vinod Thomas
Director, Independent Evaluation Group (World Bank) : Ms. Cheryl Gray
Manager, Sector Evaluation Division : Ms. Monika Huppi
Task Manager : Mr. Ramachandra Jammi
IEGWB Mission: Enhancing development effectiveness through excellence and independence in evaluation.

About this Report

The Independent Evaluation Group assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank’s self-evaluation process and to verify that the Bank’s work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEGWB annually assesses about 25 percent of the Bank’s lending operations through field work. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEGWB staff examine project files and other documents, interview operational staff, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, and interview Bank staff and other donor agency staff both at headquarters and in local offices as appropriate.

Each PPAR is subject to internal IEGWB peer review, Panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible Bank department. IEGWB incorporates the comments as relevant. The completed PPAR is then sent to the borrower for review; the borrowers’ comments are attached to the document that is sent to the Bank’s Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEGWB Rating System

IEGWB’s use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEGWB evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEGWB website: http://worldbank.org/ieg).

**Outcome:** The extent to which the operation’s major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. **Relevance** includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project’s objectives are consistent with the country’s current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, Country Assistance Strategies, Sector Strategy Papers, Operational Policies). Relevance of design is the extent to which the project’s design is consistent with the stated objectives. **Efficacy** is the extent to which the project’s objectives were achieved, or are expected to be achieved, taking into account their relative importance. **Efficiency** is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. The efficiency dimension generally is not applied to adjustment operations. Possible ratings for Outcome: Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

**Risk to Development Outcome:** The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). Possible ratings for Risk to Development Outcome: High Significant, Moderate, Negligible to Low, Not Evaluable.

**Bank Performance:** The extent to which services provided by the Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. Possible ratings for Bank Performance: Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

**Borrower Performance:** The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. Possible ratings for Borrower Performance: Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.
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This report was prepared by Ramachandra Jammi (Task Manager), who assessed the project in February 2008. Romayne Pereira and Rose Gachina provided administrative support.
### Principal Ratings

<table>
<thead>
<tr>
<th></th>
<th>ICR*</th>
<th>ICR Review*</th>
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The Implementation Completion Report (ICR) is a self-evaluation by the responsible Bank department. The ICR Review is an intermediate IEGWB product that seeks to independently verify the findings of the ICR.

**As of July 1, 2006, Institutional Development Impact is assessed as part of the Outcome rating.**

***As of July 1, 2008, Sustainability has been replaced by Risk to Development Outcome. As the scales are different, the ratings are not directly comparable.***

### Key Staff Responsible

<table>
<thead>
<tr>
<th>Project</th>
<th>Task Manager/Leader</th>
<th>Division Chief/ Sector Director</th>
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<td>Appraisal</td>
<td>William Price</td>
<td>J. Alejandro Gutierrez Wijnand</td>
<td>Heinz Vergin</td>
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<td>Completion</td>
<td>E.V. Jagannathan</td>
<td>Ridwan Ali</td>
<td>Edwin Lim</td>
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Preface

This is a Project Performance Assessment Report (PPAR) for the India Dam Safety Project.

The Dam Safety Project was approved on May 14, 1991, for a Loan of US$153 million equivalent (Loan No. 3325-IN/Credit No. 2241-IN). The project implementation was originally scheduled for six years during 1991-1997, with a total Bank credit of SDR 96.2M (US$130M equivalent) and a loan of US$23M. The project was extended by two years till 1999 to allow completion of both the physical and institutional components. At project completion, only SDR 68.8M (US$ 86M equivalent) of the credit was disbursed, while the entire loan was cancelled.

The report presents the findings of: (i) an IEG mission to India during February 4-21, 2008, including visits to 10 project-assisted dam sites in four states (Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu) and discussions with governmental officials and agencies, project directors and staff; (ii) discussions with Bank task managers and other staff in Washington D.C. and New Delhi; and (iii) a review of the project’s implementation completion report, appraisal report, legal documents, sector reports and other relevant material. The cooperation and courtesies extended to the IEG mission by all are gratefully acknowledged.

The project was selected because it was one of the first two projects (along with the Indonesia Dam Safety Project) to focus exclusively on Dam Safety, which is also the object of the Bank’s OP/BP 4.37 on “Safety of Dams” and one of the ten safeguard policies of the Bank. As such, it provides input for the ongoing major IEG Study on the Bank’s Environmental and Social Safeguard Policies, which inter alia covers activities that may contribute to the recent Bank’s pilot initiative for the use of country safeguard systems. It also provides input to the ongoing major IEG Study on the Bank’s support for Water Resource Management.

Following standard IEG procedures, the draft PPAR was sent to the Borrower for comments before being finalized. The Borrower’s comments are attached as Annex C. In accordance with the Bank’s disclosure policy, the final report will be available to the public following submission to the World Bank’s Board of Directors.
Summary

This Project Performance Assessment Report reviews the India Dam Safety Project, which was approved in 1991 and closed in 2000. This was the first Bank project in any country that was devoted entirely to dam safety. The project was prepared in response to the Government’s concerns about sustaining the existing dam structures, while making provisions to protect society against potential disasters due to dam failures.

The objectives of the project were to (i) improve the safety of selected dams in the project states through remedial works; (ii) install basic dam safety-related facilities; and (iii) strengthen the institutions of the Borrower and project states responsible for assuring dam safety.

Remedial works for dams under the project served to decrease their risk of failure and demonstrated the cycle of inspection, prioritization, design, and implementation of dam rehabilitation. The project helped to streamline data collection at the dam level through standardizing pre- and post-monsoon reports. The capacity of the Central Water Commission (CWC), the main implementing agency and the State Dam Safety Organizations (DSOs) was enhanced through training and involvement in project activities. Officials of the central and state governments, the CWC, and the DSOs reported that the project increased their awareness of dam safety issues and improved capacity to diagnose and prioritize problems. But the depth of this understanding appears to be uneven across different levels of the government. Basic dam safety facilities including instrumentation that were installed under the project were not backed up with sufficient ongoing maintenance and user training, resulting in only a marginal impact. Relatively few Environmental Action Plans have been developed. Project development outcome is rated Moderately Satisfactory.

Since project completion, the pace of remedial works has slowed due to insufficient resources. In many cases, basic dam safety facilities are not being maintained or replaced to the extent needed. While data collection emanating from the dam level is fairly streamlined, there is relatively little focus or capacity for analyzing it in a systematic manner for improving dam operations or for longer term planning. Also, less attention is paid to understanding and estimating the costs and benefits that might lead to more balanced strategies for dam safety, and improve stakeholder support. In general, the DSOs are yet to establish themselves as technically capable units for establishing priorities for dam safety, and guiding planning, implementation, and quality control. The CWC needs to play a stronger role in advocating for dam safety, upgrading and sharing its expertise, and improving coordination with DSOs. Overall Risk to Outcome is rated Significant.

The Bank deserves credit for putting together a project devoted exclusively to dam safety for the first time. It based the project design on a sound analysis of India’s dam safety needs and the country’s existing institutional strengths and weaknesses in respect of dam safety management. The Bank did well in securing the Government of India’s participation and coordinating with four large states with varied endowments and independent jurisdiction over their own dams. Supervision missions were conducted
regularly and included an appropriate mix of technical and institutional expertise. However, the Bank was optimistic about the time required to establish and build new institutions for dam safety in the states, and overestimated the capacity of CWC to coordinate project implementation. Bank performance is rated *Moderately Satisfactory*.

The Central and State Governments showed strong commitment at project preparation, and despite difficulties in the coordination and logistics of a complex operation, worked to achieve most of the project objectives. Lack of readiness at project commencement (in terms of designs for remedial works, procurement, and institutional capacity) resulted in the project taking 2-3 years to gain momentum. The schedule for remedial works (which accounted for 75% of the original project cost) was negatively affected by protracted discussions between the CWC and the state governments on methodologies and parameters for hydrological review and calculating design floods, which would form the basis for engineering design. In response to the delay in implementing remedial works, the project was restructured in 1997, and several lower priority dams were dropped while others were taken up in their place. In 1998, Tamil Nadu state withdrew from the project because it failed to meet the revised performance targets during the project extension period, resulting in some more dams being dropped from the remedial works component. Borrower Performance is rated *Moderately Satisfactory*.

The key lessons from the project are:

- Institution-building can be a long process when it involves organizations at multiple levels, establishing new work methods, and upgrading technical expertise. In such cases, the Bank should consider an extended commitment through a sequence of projects or through adaptable program lending (APL).
- Institutions that carry out regulatory functions require technical expertise and adequate resources to be able to function in a capable and independent manner. In this project, shortage of experienced/qualified staff and inadequate operating budgets contributed to the under-performance of the state dam safety organizations.
- When new monitoring and reporting procedures are instituted, their purpose should be made clear to all those involved, and appropriate and regular feedback should be given to those originating the data. In this project, there was little systematic analysis or feedback from higher levels on reporting emanating from the dam level, which may be affecting its quality and compliance.
- New techniques and equipment should be tailored to the existing level of capacity, facilities and funds for ongoing maintenance. A significant portion of the relatively sophisticated instrumentation installed at dams under this project has deteriorated for lack of maintenance or use.

Vinod Thomas  
Director-General  
Evaluation
Background

1. Dams are structures for water storage and use in water supply, irrigation, hydropower, and flood control. They play a crucial role in major sectors of economic activity and may contribute to poverty reduction. At the same time, dams can be associated with negative environmental and social impacts including those caused by natural disasters such as floods and earthquakes. Dam safety concerns itself with the adequacy of the operations and maintenance of dams, limiting their possible adverse impacts on human life, health, property, and the environment, as well as plans for dealing with emergencies. Preserving dam safety can also improve the efficiency of water resource use, while keeping the dams environmentally and socially sustainable.

2. According to estimates by the World Commission on Dams (WCD), there are presently around 45,000 large dams in the world, with the largest numbers in China (22,000), U.S.A (6575), India (4,291), Japan (2675) and Spain (1196).

3. The World Bank has been involved in financing dams and ancillary facilities since the 1960s, though the rate of involvement slowed sharply in the mid-1980s, with the focus shifting towards ancillary facilities. In recent years, there has been greater emphasis on promoting dam rehabilitation and safety. At the end of FY2008, there were around 70 active projects containing components relating to dam rehabilitation or safety assessment. Of these, three projects in Sri Lanka, Armenia and Albania are mainly concerned with dam safety.

4. In 1977, the Bank issued its first formal policy on “Safety of Dams” underscoring the importance of dam safety measures to address issues arising from inadequate design or natural phenomena. After revisions that incorporated new thinking on dam safety issues, the current version of the Bank’s policy was issued in October 2001 (Operational Policy [OP] 4.37). The standards set by this policy are at least as stringent as those recommended by the WCD. “Safety of Dams” is also one of the ten Safeguard Policies of the World Bank, which require that potentially adverse environmental and social impacts of Bank-financed projects be identified, mitigated, and monitored.

References

2. The World Commission on Dams (WCD) was established in 1988 with a mandate to review the development effectiveness of large dams and develop internationally acceptable criteria, guidelines and standards for large dams.
3. Large dams are defined as those having a height of 15 meters or more and/or a reservoir capacity of at least 500,000 cubic meters.
4. Sri Lanka: Dam Safety And Water Resources Planning Project (DSWRPP); Armenia: Irrigation Dam Safety 2 Project; Albania: APL 5 For Albania Dam Safety.
5. India is a developing country with a population of 1.1 billion and a Gross National Product (GNP) per capita\(^6\) of US$820. Agriculture accounts for 18% of Gross Domestic Product and involves nearly 70% of the population. India is a water-short country for its agricultural, municipal and industrial needs. With seasonal rainfall and limited groundwater potential, the country is dependent to a great extent on surface storage of water. Around 4300 large dams provide irrigation for over 35 million hectares of land apart for producing hydroelectricity, serving municipal and industrial needs, and helping in flood control.

6. According to the Staff Appraisal Report (SAR) of the India Dam Safety Project there were about 2,900 large dams in India at the time of project preparation in 1991 of which nearly 800 were considered to be at risk due to ageing, poor maintenance and lack of compliance with dam safety standards and practices.

7. India’s constitutional framework gives each state the primary responsibility with respect to water resource development. The central Ministry of Water Resources (MOWR) and the Central Water Commission\(^7\) (CWC, the main implementing agency for this project) have substantial authority to issue guidelines and review standards relating to dam safety, but have virtually no powers of actual enforcement. The CWC ensures that projects on inter-state rivers are consistent with downstream safety requirements, an important role which individual states cannot undertake. The CWC also monitors and reviews projects proposed for central support by the National Planning Commission in each State Development Plan.

8. In India, the importance of dam safety was recognized as early as 1979\(^8\), when a Dam Safety Organization (DSO) was established in the CWC for assisting states in evaluating safety-related hazards in existing structures. In 1982, the National Committee on Dam Safety\(^9\) was created and produced a report on Dam Safety Procedures (1986) and Guidelines for Safety Inspection of Dams, which established standards that conformed to those of the International Commission of Large Dams (ICOLD)\(^10\). The Hydrology Organization of the CWC performs hydrologic analysis for nationally important dams and others that are part of new major irrigation projects and assists state governments on these issues.

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\(^{6}\) Atlas method.

\(^{7}\) Central Water Commission is the premier technical organization of India in the field of Water Resources and is an attached office of the Ministry of Water Resources, Government of India. CWC, in consultation with the state governments, initiates and coordinates schemes for control, conservation and utilization of water resources throughout the country, for the purpose of Flood Control, Irrigation, Navigation, Drinking Water Supply and Water Power Development.

\(^{8}\) In comparison, major reforms to dam safety procedures were introduced in 1972 in the U.S. and in 1975 in the U.K.

\(^{9}\) National Committee on Dam Safety (NCDS) is a forum for discussions on dam safety issues among the Central, State Govt. and dam owning agencies.

\(^{10}\) The International Commission on Large Dams (ICOLD) is a non-governmental International Organization which provides a forum for the exchange of knowledge and experience in dam engineering.
9. Capacity to carry out effective dam safety assurance programs varies substantially from state to state due to staffing levels, training, degree of experience and procedures. While dam safety assurance is a joint concern of the state and central organizations, it is the state that must eventually provide the necessary staff and equipment to monitor the population of dams within the state.

10. Since the 1970s, the Bank has been funding irrigation, power, and water supply projects that have directly or indirectly involved at least 150 dams. The India Dam Safety Project was prepared in response to the government's concerns about sustaining the existing dam structures, while making provisions to protect society against potential disasters due to dam failures. It was the first Bank project to focus exclusively on dam safety issues. Presently in India, there are six active projects that contain dam safety or rehabilitation components. The Dam Rehabilitation and Improvement Project (DRIP), which is currently under preparation, seek to build upon the India Dam Safety project.

The Project

11. The objectives of the project were to:

1. Improve the safety of selected dams in the project states through remedial works;
2. Install basic dam safety-related facilities; and
3. Strengthen the institutions of the Borrower and project states responsible for assuring dam safety.

12. Throughout the project period, the Indian Rupee depreciated against the US Dollar, resulting initially in the cancellation of the entire loan of US$23m by 1995. Following restructuring in 1997, SDR 20m (US$27.2m) of credit was cancelled. After Tamil Nadu dropped out of the project in 1998, a further SDR 7.4m (US$10.1m) credit was cancelled. In Rupee terms, final project cost was 93% of the appraisal estimate, while it was 59% in terms of US$.

13. The project implementation was originally scheduled for six years during 1991-1997, with a total Bank credit of SDR 96.2 million (US$130m equivalent) and a loan of US$23m. The project was ultimately extended till 1999 to allow completion of both the physical and institutional components. At project completion, only SDR 68.8m (US$86m equivalent) of the credit was used, while the entire loan was cancelled.

11. Karnataka Tank Management Project; Rajasthan Water Sector Restructuring Project; Madhya Pradesh Water Sector Restructuring Project; Maharashtra Water Supply and Irrigation Project; Andhra Pradesh Water Sector Improvement Project; Luhri Hydroelectric project.

12. 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.
14. The project had 5 components which are listed in the Table 1 below, together with the corresponding objectives, planned cost, and actual cost.

<table>
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<tr>
<th>Objectives (as listed above)</th>
<th>Component</th>
<th>Planned Cost US$M</th>
<th>Actual Cost US$M</th>
<th>Actual as % of Planned Cost</th>
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</thead>
<tbody>
<tr>
<td>Objective 1</td>
<td>Remedial works at dams selected in accordance with criteria established by Dam Safety Committees.</td>
<td>147.1</td>
<td>76.2</td>
<td>52</td>
</tr>
<tr>
<td>Objective 2</td>
<td>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,</td>
<td>27.0</td>
<td>21.9</td>
<td>81</td>
</tr>
<tr>
<td>Objective 3</td>
<td>Institutional strengthening of CWC’s Dam Safety Organization, Hydrology Organization (HO) through assignment of staff, training, technical assistance, provision of equipment and consultant support,</td>
<td>3.0</td>
<td>3.1</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>Reviewing the existing flood forecasting facilities in one or more selected interstate river basins and exploring the possibility of improving such facilities.</td>
<td>10.7</td>
<td>4.3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Technical assistance to Dam Safety Committees (DSC) to be established in each project state; and institutional strengthening of state Dam Safety Organizations 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.</td>
<td>9.0</td>
<td>9.7</td>
<td>108</td>
</tr>
</tbody>
</table>

**DESIGN**

15. The project design recognized the need to increase awareness and improve institutional capacity for dam safety at the central and state levels. It also recognized the large number of dams in need of rehabilitation (nearly 800 or 18% of all dams at project preparation). Project design therefore appropriately combined features that addressed institutional capacity-building while taking up the rehabilitation of selected dams in all four project states that would serve to demonstrate the entire cycle of inspection, prioritization, design and rehabilitation.

16. The project design took note of problems that were commonly experienced in previous Bank-financed irrigation projects including delays in procurement, timeliness and adequacy of counterpart funds, and lack of continuity of staff in state implementing
agencies, and attempted to mitigate them through dialogue and assurance of commitment from the government and implementing agency.

17. The project team considered several states before selecting four (Orissa, Madhya Pradesh, Rajasthan and Tamil Nadu) on the basis of institutional readiness and government interest and commitment. While this initially appeared to be a manageable number, coordination among the DSOs of the four project states, CWC, and external consultants and the logistics of organizing physical works in dispersed locations, proved to be challenging. At project preparation, these four states had about 947 large dams or approximately one-third of all large dams in the country.

18. The CWC was designated as the main implementing agency and its Dam Safety Organization as the focal point for implementing the project. The lack of constitutional authority and legislation for CWC to enforce a national program of dam safety assurance was recognized as a problem, but the project did not address its implications sufficiently.

IMPLEMENTATION

19. Project implementation was delayed due to several reasons. Lack of readiness at project commencement (in terms of designs for remedial works, procurement, and institutional capacity) resulted in the project taking 2-3 years to gain momentum, and affected implementation throughout. The schedule for remedial works (which accounted for 75% of the original project cost) was negatively affected by protracted discussions between the CWC and the state governments on methodologies and parameters for hydrological review and calculating design floods, which would form the basis for engineering design. In this situation, CWC’s role as a consultant to the states made it difficult for it to have an authoritative role in ruling on its own analysis. As a result, at the start of the project, designs were not ready even for top priority Category A dams.

20. The Basic Dam Safety Facilities (BDSF) component experienced delays in procurement and installation of instruments at dams due to difficulties in mobilizing contractors for small works at scattered locations. In general, for both remedial works and BDSF, there were many procurement delays due to cumbersome administrative arrangements and lack of familiarity with Bank procedures, aggravated by frequent changes of staff. Shortfalls in counterpart funds during the working season further

13. CWC had the responsibility for performing the hydrology review and calculating design floods for dams that were slated for remedial works. CWC found it difficult to combine its role as consultant and to defend its own analysis. There were differences between the CWC, and Dam Safety Review Panels and Dam Safety Organizations (DSOs) on the application of Probable Maximum Precipitation (PMP) and unit hydrograph methodologies. As a result, Hydrological reviews and Design flood computations for the target group of dams were delayed by 1-3 years, and the entire process was not completed till end-1993 or mid-1994. For a few large reservoirs like Hirakud and Gandhisagar, this was completed even later.

14. 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.)
contributed to delays in awarding contracts for both remedial works and BDSF. *Institutional strengthening at CWC's Dam Safety Organization* was affected due to tardiness in redeploying staff in the unit, with the result that the full staff complement was in place only during the extended project period. Frequent rotation of staff required increased training efforts at CWC as well in the four project states.

21. In response to the delay in implementing remedial works, the project was restructured in 1997, and 7 out of the original 33 Category A dams were dropped from the project, while 14 Category B dams were taken up. It is not clear as to why the decision to restructure the project was taken so close to the original closing date. In 1998, Tamil Nadu withdrew from the project because it failed to meet the revised performance targets during the project extension period, resulting in 5 more Category A dams being dropped from the remedial works component.

**MONITORING AND EVALUATION**

22. **Design and Implementation.** In general, project outcome indicators were not well articulated in the project SAR. For instance, the most important indicator, improvement in dam safety, was not defined in terms that would enable a before and after comparison. Targets for basic dam safety facilities were specified only in monetary terms. Institutional development in CWC and the State Departments and DSOs was defined in output terms such as number of persons trained and staff strength. It is recognized that this project was prepared several years before the Bank adopted a log-frame approach of specifying a causal chain from inputs to outputs and outcomes, with corresponding indicators. The project SAR provided a detailed schedule of training events under the project for tracking implementation. The participating states were required to submit annual reports on progress in respect of dam status and project activities. These reports covered the progress of Phase I and II inspections and evaluations, manpower assigned to these activities, and factors causing a shortfall in the scheduled activities. Compliance with reporting requirements was satisfactory but the reports were not always received on time.

23. **Utilization.** The utilization of data from the periodic reports was essentially to track outputs, uncover factors for slow progress, and try to address them. To this extent, the purpose of the reports in providing feedback and corrective action for implementation was served. Overall, M&E is rated *Modest.*

**Project Evaluation**

**RELEVANCE**

24. **Relevance of Objectives.** At project preparation (as at present), India had a large number of dams that required a safety review and possible rehabilitation. Even though the Government of India (GOI) had created a Dam Safety Organization (DSO) in the CWC as early as 1979, and established a high level National Committee on Dam Safety in 1982, the pace of activities addressing dam safety was low. There was a shortage of
funds for maintaining dam safety institutions and for dam operations and maintenance (O&M). There were not enough trained specialists and staff dedicated to dam safety at the center as well as in the states. Therefore, the project objective of strengthening institutions at all levels was well founded. Improving the safety of prioritized dams through remedial works and installing basic safety facilities were consistent with the project objectives because – apart from the immediate reductions in risk that would be realized for the assisted dams – it would create a demonstration effect for a systematic approach to dam safety. The Bank’s Country Assistance Strategies (CAS 1995, 1997, 2001 and 2004) consider water resource development as a major area of focus including the need to control and exploit India’s limited water supplies. In this context, dam safety assurance is necessary to reduce risks and help assure sustainability and full operational capacity of existing storage through early identification and rectification of problems. On the whole, relevance of the project objectives is rated high.

25. **Design of project components.** The design of the project’s components had some drawbacks, most of which are more obvious in retrospect. The time-frame for planning and executing remedial works was under-estimated. The Basic Dam Safety facilities component could have chosen instrumentation that was better suited to local conditions and capacity, and included a provision for their ongoing maintenance. Institutional strengthening did not provide adequately for training at the level of dam operators (as distinct from staff of the CWC, MOWR, and State Government and State DSO officials). Under the flood-forecasting component, too much emphasis was placed on the design flood and structural solutions as the determinant of safety, with less regard to the general flood regime and the flood operation of dams. Also, the project should have recognized a lack of appreciation of the importance of historical data across the states.

26. In retrospect, the capacity of CWC to coordinate project implementation across the states was overestimated. Further, there was little separation between CWC’s role as a consultant to the states and having to rule on its own analysis, especially in respect of hydrological parameters.

27. The project SAR paid relatively less attention to the costs and benefits of improving dam safety, and put greater emphasis on the technical and process aspects of addressing dam safety. It could have framed the project objectives in a broader cost-benefit framework, making clear and illustrating the benefits from improving dam safety in terms of reducing the risk of economic losses (downstream loss of life and property, and adverse environmental effects), while improving other direct and indirect benefits such as water use efficiency. Relevance of design is therefore rated Modest. Taking into account the innovative nature of the project and the complex institutional and technical issues that needed to be tackled simultaneously, the overall relevance is rated Substantial, though marginally so.

15. Design Flood: The maximum amount of water for which a flood control project will offer protection. Selection is based on engineering, economic and environmental considerations.
Efficacy

Objective 1. Improve the safety of selected dams in the project states through Remedial Works (Rating: Substantial)

28. In all, 33 dams in four states were fully rehabilitated at project completion consisting of 17 Category A dams (out of the original set of 33 Category A dams identified at appraisal) and 16 Category B dams identified at restructuring. The 16 Category A dams remaining from the original set were partly rehabilitated. (Table 2) According to the project ICR, the project-assisted dams benefited from a reduction in seepage through dams, structural improvements and increased spillway capacities. As a result the safety status of the dams was improved. During site visits to ten project-assisted dams (see list in Annex B) state government officials indicated that the benefits from remedial works to the project-assisted dams had been largely sustained. These included repairs/enhancements to the dam structure, dam crest rehabilitation, stabilization of embankments and replacement or repair of gates.

<table>
<thead>
<tr>
<th>State</th>
<th>Remedial Works</th>
<th>Basic Dam Safety Facilities completed (no. of dams)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned</td>
<td>New Completed (All Category B)</td>
</tr>
<tr>
<td></td>
<td>Completed</td>
<td>Partially Completed</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Orissa</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>TOTAL</td>
<td>33</td>
<td>182</td>
</tr>
</tbody>
</table>

Objective 2. Install basic dam safety facilities\(^{16}\) for improving dam safety (Rating: Modest)

29. The target for basic dam safety facilities was indicated only in financial terms because identification of specific needs was not completed at the beginning of the project. The financial target was exceeded by 30% (INR 788 million against a target of INR 604 million), but the actual supply of instrumentation was less than expected at project appraisal, mainly due to contracting problems. Overall, the objective of improving dam safety through better monitoring, communications, and access was served through the construction/improvement of access roads (181 dams), standby power supplies (103 dams), stockpiling of strategic materials and provision of monitoring instruments (172

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\(^{16}\) Basic Dam Safety Facilities are broadly defined as items that assist the operation and maintenance personnel at the dam to assess emergency situations and to respond with timely actions. These include Surveys (key drawings, reservoir capacity surveys); Communications (primary and secondary communication links for operational and flood warning purposes); Instrumentation (Seepage: V-notch weirs; seepage flow recorders; reservoir level gauges and recorders; rain gauges); Site preparation (clearance of dam and surrounding area); Emergency actions (Emergency actions plans).
dams), and communication systems (148 dams). However, it is not clear as to how much of the instrumentation is in working condition.

30. In the 10 dams covered by site visits, state officials generally indicated that basic instrumentation (especially for measuring rainfall, water level, and discharge) was largely in working condition. But in about half of this dam instrumentation such as piezometers, stress gauges, and automated equipment for recording various data was in need of replacement or repair. Access roads, back-up power systems and communication facilities that were installed during the project have been generally maintained well or have been allocated funds by the government for that purpose. However, in general, resources for maintenance or replacement of instruments were reported to be low. At several dams, officials expressed the need for more guidance for identifying, installing and using appropriate instrumentation.

31. There was little progress in preparing Emergency Action Plans (EAPs) to deal with the potential downstream consequences of dam failure. Madhya Pradesh reported the preparation of 4 EAPs including one for the major Gandhisagar dam, while Orissa has recently prepared 2 EAPs.

Objective 3. Strengthen the institutions of the borrower and project states responsible for assuring dam safety (Rating: Substantial)

Institutional strengthening and CWC’s Dam Safety Organization and CWC’s Hydrology Organization (Rating: Substantial)

32. The project contributed to the Dam Safety Organization and the Hydrology Organization in the CWC by providing equipment and training. Training for CWC during the project included study courses, workshops, seminars, and 38 man-months of study tours and training abroad. This served to improve CWC’s capacity to review hydrology, prepare Probable Maximum Precipitation (PMP) atlases, design flood computation procedures, prepare models for operation of gated spillways, carry out dam break analyses, and prepare guidelines for emergency procedures. But the impact of training during the project may have been reduced to some extent due to retirements and turnover of staff, and relatively little follow-up training.

Review of existing flood forecasting facilities (Rating: Substantial)

33. Flood forecast networks were installed in the Mahanadi (Orissa) and Chambal (Madhya Pradesh and Rajasthan) basins by the CWC and data was made accessible at the receiving stations at the dams. As part of this effort, the CWC prepared PMP Atlases for the two river basins. Since project completion, PMP Atlases have also been prepared for the Ganga and Brahmaputra river systems, and all PMP atlases in general are being digitized.

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17. A spillway is a structure used to provide for the controlled release of flows from a dam or levee into a downstream area, typically being the river that was dammed.

18. An analysis that provides an estimation of downstream flooding effects following dam failure.
34. State and dam site officials largely agree that CWC is generating important and timely data for decision-making. But officials of both the CWC and the state government were not able to provide a clear explanation as to why they were not able to integrate this data with better operating rules for dam operations. In particular, the project missed a clear opportunity to fully study the possible ways of dealing with the revised design flood at the Gandhisagar – a dam of national importance – and at its downstream cascade of dams.

35. The CWC broadly met its targets for estimating design floods during the project, and generally demonstrated its capacity for hydrological and structural reviews of dams and for executing the entire cycle of inspection, prioritization, and preparation of plans of action for ensuring dam safety.

Technical strengthening of Dam Safety Committees, Dams Safety Organization, Departments of Water Resources/Irrigation/Public Works (Rating: Modest)

36. During the project, all four state DSOs emerged as distinct and permanent units of the larger departments of water resources/irrigation/public works. The DSOs were adequately staffed in all the four states except Tamil Nadu, where the staff was reduced towards the end of the project. The DSOs benefited from training and services of consultants, and were provided with office space, office equipment, and vehicles.

37. Since project completion, the Rajasthan DSO has been merged with the Dam Directorate, effectively losing the separation between the regulatory and operational functions. In Madhya Pradesh, Orissa and Tamil Nadu, the DSOs continue to be independent units but generally face a shortage of staff, capacity, office space and equipment, and operating budgets. As a result, nearly all states have not kept up with their schedule of Phase I/II inspections with the result that the overall status of dam safety cannot be gauged with any certainty. They are also unable to do any meaningful analysis of dam-level data for long-term planning. The general feeling

19. CWC also had the task of estimating design floods for 33 (later increased to 55) projects identified for remedial works. By project completion, CWC had carried out hydrologic review of 128 dams (appraisal estimate of 170) and gave procedural clearance for structural review/carried out structural review of 49 dams (appraisals estimate 44).

20. Dam Safety Committees typically are chaired by the State-level departmental head with Head of the state DSO as Secretary, and representatives from other concerned ministries and technical specialists, and typically meets around twice an year to consider dam safety issues.

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

22. At project completion, progress on inspections was generally satisfactory (Phase I: 1510 vs. 947 targeted; Phase II: 81 vs. 147 targeted). Since then, in Orissa, 3 expert panels have completed the Phase I cycle of inspections, but Phase II is behind schedule due to shortage of staff. Tamil Nadu has completed the Phase I inspection cycle, and Phase II began in 2008. Madhya Pradesh and Rajasthan are lagging behind in their inspection schedules due to shortage of staff.
among state officials was that a posting in the DSO was not an attractive career proposition. However, the specific situations differ between state DSOs.

38. At project completion, the effect of training provided to officials at the state level was difficult to gauge. It was felt that the training was not correctly targeted, and did not adequately cover the crucial category of dam level engineers and operators. There has been relatively little training on dam safety since project completion. CWC officials indicated that regular training is offered on dam safety and instrumentation at its National Water Academy in Pune. Feedback from DSOs suggests that only two of their officers have taken advantage of the CWC training. In general, the DSOs reported a strong need for training in the fields of hydrology and reservoir operation. The Orissa DSO has taken the initiative of conducting some basic training courses on dam safety and quality control for staff in two river basin areas in the state.

39. **Data Collection and Analysis.** Pre- and Post monsoon reporting on dam status in a standardized format was introduced by the project. This procedure generally works well in all four states except for some delays and lack of compliance is some cases. These reports are consolidated by each state in an annual “Health Status of Dams” report to the CWC. However, the CWC reports delays in receiving these reports from some states though it is not clear if this includes the project-assisted states. All states use the reports to differing extents to categorize dams in terms of hazard and to identify priority remedial work needs. Orissa and Tamil Nadu reported sending some feedback to the reporting dams. In spite of this, many state officials felt that the data from pre- and post monsoon reports is not analyzed to any significant extent and that the procedure has become a “paper exercise”.

40. **Dam Safety Committees** and **Dam Safety Review Panels**. Orissa and Tamil Nadu have Dam Safety Committees that meet around twice a year to review dam safety issues. The two states also constitute expert groups for periodic dam inspections. Dam Safety Review Panels that were created during the project no longer exist except in Rajasthan where it is required under the Rajasthan Water Sector Restructuring Project. Orissa and Tamil Nadu prefer ad hoc expert committees to carry out the functions of Dam Safety Review Panels.

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23. The specific situations differ between DSOs. In Orissa, the staffing position was said to be relatively better, though more expertise in hydrology is needed. Some indicative feedback: The Orissa DSO has obtained a renovated computer room and computer equipment, and is developing a dedicated mini conference room and data library for all dams in the state. DSO in Madhya Pradesh has been relocated from its original premises, with less access to office equipment. The Tamil Nadu DSO has basic office facilities and some computer equipment, but lacks space even for storing past reports from dams.

24. For instance, Madhya Pradesh officials reported around 70% compliance.

25. Dam Safety Committees are chaired by the State Department Head with the State DSO Head as secretary, and include technical specialists and members from concerned ministries.

26. Dam Safety Review Panels were required to be established for dams where remedial measures are proposed to be undertaken, and consisted of four to five experts. These were expected to become regular features after project completion.
41. Substantial progress has been made in the institutional strengthening of CWC’s DSO and Hydrology organization, and in improving flood forecasting facilities. But there was only modest improvement in the technical capabilities of Dam Safety Committees and state DSOs. Data collection at the dam level has been streamlined but is not analyzed to a significant extent on a regular basis. Dam Safety Committees and Panels continue to operate at least on a periodic basis in three out of the four project states. In the balance, dam safety institutions have been strengthened to a substantial extent at the center and the states. Taken together with substantial and modest efficacy respectively for the first two objectives, overall efficacy is rated substantial.

EFFICIENCY

42. Most project components encountered delays to different extents. Remedial works were delayed due to lack of preparation while basic dam safety facilities were delayed due to delays in procurement and mobilizing contractors at scattered locations (see section on Implementation). Procurement and installation of novel instruments and dedicated software for flood warning systems was more than three years behind schedule due to differences between the CWC and the Bank on design modalities and on deployment of staff. Final project costs appear commensurate with the revised targets for remedial works.

43. The project put a lot of emphasis on the design flood as a determinant of safety. Safety was seen as an end in itself rather than as a part of the wider benefits that may also be gained by the appropriate operation of the dam in times of flood. In other words, structural issues (such as adequate spillway capacity) were stressed perhaps at the expense of non-structural issues (spillway operation, flood mitigation).

44. The project SAR took the position that conventional Cost-Benefit Analysis may not be appropriate for this project. The main benefit would be the prevention of potential loss of life and property and damage to the environment downstream, which were considered difficult to estimate. The concept of prioritization of dams and rehabilitation measures was therefore adopted with little care to an objective and technically sound assessment of risk. In some cases, dam serviceability has been addressed rather than safety.

45. While noting that risk assessment for dams continues to be a work in progress worldwide, the project could have considered the large number of direct and indirect benefits from a dam safety program that may be more readily estimated, such as increased water supply for domestic and industrial use, irrigation, power generation, fishery and recreation. The project ICR could have made an attempt at quantifying some of these benefits, which may have largely justified investments in dam safety. Taking

27. For instance, the ICR for the Bank’s Indonesia Dam Safety Project notes that after rehabilitation of the Jatiluhur dam, the water level in the reservoir was first drawn to a minimum level (76 meters) during the 1997 dry season, which could not have been done earlier due to safety considerations. This helped ensure a continuous supply of irrigation water to 200,000 ha of rice fields downstream from the dam, and the ICR estimates that the value of the crop that was saved is likely to have more than offset the cost of rehabilitation.
into account the time overrun and the lack of sufficient evidence for establishing benefits, the project’s efficiency is rated *Modest*.

**OUTCOME**

46. The project documents do not specify any outcome indicators to assess performance against objectives. One approach to assessing outcomes is to review the safety status of the country’s dams as determined by the latest inspections, but such information is incomplete or outdated. CWC officials conveyed orally to the IEG mission that the incidence of dams in distress is low. However, records indicate that the CWC does not have up-to-date and comprehensive data on the safety status of dams. Further, the states do not consistently report problems or dam failures to the CWC. Hence the value of CWC’s informal assessment on the overall dam safety in the country is limited.

47. On the whole, officials of the central and state governments and the CWC and State DSOs reported that the project increased awareness of dam safety issues and improved capacity to diagnose and prioritize problems. But the depth of understanding is uneven. Thus, even at higher levels of national planning, dam safety is not convincingly viewed in a cost-benefit framework, and receives relatively routine attention in the latest five-year national plan. Senior state officials appear to understand the dimensions of dam safety, but many others still view it in a narrowly technical manner.

48. *Remedial works* for dams under the project served to decrease the risk of failure and also demonstrated the whole cycle of inspection, prioritization, design, and implementation of dam rehabilitation. However, the pace of remedial works since project completion has been slow due to insufficient resources. *Basic dam safety facilities* were not backed up with sufficient user training and ongoing maintenance, resulting in only a marginal impact. Relatively few Emergency Action Plans have been developed.

49. The project has helped to streamline data collection at the dam level through standardizing pre- and post-monsoon reports. The concept of prioritization of dams and rehabilitation measures has been adopted. Institutional strengthening in terms of creation and operation of permanent DSOs equipped with requisite staff carrying out periodic inspections of the health status of dams has been partly achieved. DSOs are yet to establish themselves fully as technically capable units capable of establishing priorities for dam safety, and guiding planning, implementation, and quality control. DSO officials ascribe this to being inadequately staffed, low opportunity to upgrade capacity, and insufficient operating budgets.

50. On the basis of *Substantial Relevance*, *Substantial Efficacy* and *Modest Efficiency* the overall project outcome is rated as *Moderately Satisfactory*.
Implied Development Objectives of
each Project Component

<table>
<thead>
<tr>
<th></th>
<th>Relevance</th>
<th>Efficacy</th>
<th>Efficiency*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve the safety of selected dams in the project states through remedial works</td>
<td>Substantial</td>
<td>Substantial</td>
<td>-</td>
</tr>
<tr>
<td>Install basic facilities for improving dams safety</td>
<td>Modest</td>
<td>Modest</td>
<td>-</td>
</tr>
<tr>
<td>Strengthen the institutions of the borrower and the project states responsible for assuring dam safety</td>
<td>Substantial</td>
<td>Substantial</td>
<td>-</td>
</tr>
</tbody>
</table>

Overall Outcome: Moderately Substantial Satisfactory

*Efficiency has been rated for the project as a whole.

RISK TO DEVELOPMENT OUTCOMES

51. While the project had several positive outcomes, there are risks that need to be addressed. Awareness of dam safety has increased, but it is still largely viewed in narrowly technical terms at all levels of government. Relatively less attention is paid to understanding and estimating the costs and benefits that might lead to more balanced strategies for dam safety. Also, lack of cost-benefit estimates can make it more difficult to build support among various stakeholder groups including within the government itself. Senior officers in the participating state governments felt that the case for dam safety is not being made adequately by their Dam Safety Organizations, to strengthen their hands in seeking more resources.

52. Capacity for dam safety may be eroding at various levels due to the lack of sufficient follow-up training and high staff turnover at all levels. Lack of training for dam level operators and engineers is an especially important gap since frequent transfer of key staff poses a risk to sustainable safe operation of reservoirs with gated spillways.

53. In general, the central role of Dam Safety Organizations in the review, prioritization, and quality control of dam safety efforts is not being carried out to its potential. This is due to inadequate staffing, capacity, operating budgets, computer equipment and other office facilities. Broadly speaking, staff does not seem to view a DSO posting as an attractive option due to real or perceived lack of incentives in terms of career progression.

54. Many state officials feel that the CWC’s role in being an advocate for dam safety at the highest level, sharing its expertise with the states and helping to build their capacity is not up to expectations. At the same time, the states do not always seem to be inclined to seek CWC’s expertise even in areas where it has a clear edge such as hydrology and basic dam safety facilities. A clear opportunity for synergy between the CWC and the states is being underutilized.

55. The culture of data collection and analysis for long-term planning and guiding dam operations has not improved much since project completion. General data on the
safety status of dams and problem occurrences at the level of CWC appears to be incomplete and outdated. While dam level reporting is fairly streamlined and regular, there is relatively less emphasis and little or no capacity at the state level for analyzing the data. Instrumentation at many dam sites needs to upgraded and maintained. Yet, there is a large body of historical data that that exists at many dams that lies unprocessed. The CWC has begun work on an ambitious Dam Health and Rehabilitation Monitoring Application (DHARMA) data collection exercise covering the entire country. While the states are complying with their reporting requirements, some state officials had reservations about the feasibility and utility of the exercise in it is current form.

56. According to central and state government officials, remedial works since project completion are occurring at a much lower pace than during the project mainly due to lack of sufficient funds. In most states, budgets for dam O&M are part of the larger budget for irrigation and canal maintenance which is decided on the basis of irrigated area. In practice, irrigation and canal maintenance tend to get greater priority, with the result that dam O&M is relatively neglected. Allocations for dam O&M need to be more in line with need-based assessments. A small start has been made in Orissa and Tamil Nadu in earmarking funds for Dam-related O&M. In Orissa, a “critical lump fund” has been created in 2007 with a modest initial allocation, while in Tamil Nadu, 15% of the irrigation budget has been earmarked for dam headworks.

57. While there are several sources of risk for outcomes from this project, it should be kept in mind that the project added clear value to an essentially functioning and time-tested framework for dam safety at all levels of the government and dam locations. Overall, the risk to project outcomes is rated Significant.

SAFEGUARD COMPLIANCE

58. The project was appropriately classified in Category B for compliance with the Bank’s safeguard polices. The project SAR indicated that environmental effects from constructions works were expected to be limited and of short duration. Assurances were obtained from participating states that they would identify any environmental impacts of project works, and prepare environmental impact assessments indicating the nature and time-frame for mitigation measures. However, there is no evidence that this was done.

STRENGTHENING COUNTRY SYSTEMS FOR DAM SAFETY

59. All of the project’s components served to strengthen the institutional and regulatory frameworks for dam safety in India. These efforts are in line with the principal objectives of the Bank’s Safeguard OP 4.37 for “Safety of Dams”.

28. The pace is relatively higher in Rajasthan due to the ongoing Water Sector Restructuring Project, which has a component for dam safety related O&M.

29. Two important objectives of the Bank’s Safeguard policy for “Safety of Dams” (OP 4.37) are to: (i) work with the borrowing countries to strengthen their institutional, legislative, and regulatory frameworks for dam safety programs; and (ii) ensure that the borrower adopts and implements dam safety measures for the design, bid tendering, construction, O&M of the dam and associated works, and to make sure that experienced and competent professionals design and supervise construction.
The project also attempted to streamline and update the a set of dam safety regulatory guidelines to bring the country’s standards in line with those of the Bank. This facilitated the Bank’s new approach for using Country Systems for environmental and social safeguards in future projects that involve dam safety and rehabilitation.

Thus the project has helped to advance the framework of safeguards for safety of dams in the country and to mainstream it to a greater extent at the central and state levels. However, as discussed under the section on Outcome, India has a long way to go in consolidating its dam safety institutions, especially in providing them with adequate resources to function effectively.

**BANK PERFORMANCE**

The Bank deserves credit for putting together an exclusive project devoted to dam safety for the first time. The experience from this project has helped to design a similar project in Indonesia (1994-2003), and influenced three active projects on dam safety in Albania, Armenia, Sri Lanka. The Bank based the project design on a sound analysis of India’s dam safety needs and the country’s existing institutional strengths and weaknesses in respect of dam safety management. In technical terms, the project design conformed to ICOLD’s guidelines and OP 4.37 on “Safety of Dams” which was issued several years later by the Bank. The Bank did well in securing the Government of India’s participation and coordinating with four large states with varied endowments and independent jurisdiction over their own dams.

As discussed in the section on Design, there were several weaknesses in project preparation and appraisal resulting in weak quality at entry. Importantly, the Bank could have made a better effort at estimating the benefits from the project or at least enumerating the various benefits clearly. This was also reflected in the relatively weak design of performance indicators which were mainly in terms of project outputs. The Bank was optimistic about the time required to establish and build new institutions for dam safety in the states, and overestimated the capacity of CWC to coordinate project implementation. The time to establish and work through many new technical procedures and to agree on the various hydrological parameter estimates was also underestimated. The Bank did not adequately balance structural solutions to meet new design flood requirements against the use of more systematic operating rules for dams with gated spillways. Considering that this was the first project of its kind, and that several shortcomings at appraisal and design may not have been easy to anticipate at that time, quality at entry is rated Moderately Satisfactory.

Supervision missions were conducted regularly and included an appropriate mix of technical, institutional and expertise. However, they faced a difficult task in covering dam sites in far-flung areas in the four project states. The supervision missions were

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30. In 2005, the Bank launched a Country Systems pilot to explore using a country’s own environmental and social safeguard systems, where they are assessed as being equivalent to the Bank’s systems, in Bank-supported operations. Key to the approach would be an increased emphasis by the Bank on capacity-building.
persistent in working with the CWC and the states in resolving various bottlenecks that were faced during project implementation, but were not always able to ensure that annual progress reports were submitted regularly. Supervision performance is rated Satisfactory. Overall, Bank performance is rated Moderately Satisfactory.

**Borrower Performance**

65. The central government and participating state governments were receptive to the innovative nature of this project. They displayed a significant level of cooperation and commitment at preparation and during implementation, given the complex nature of the project and institutional relationships. Towards the end, Tamil Nadu withdrew from the project due to disagreement with the Bank on procurement matters and unsatisfactory progress with remedial works. During the project, the central government strengthened the Dam Safety Organization and Hydrology Organization in the CWC, while the states created Dam Safety Review Panels and strengthened their DSOs. The Department of Economic Affairs and the MOWR played their role adequately in reviewing progress and responding to the project restructuring and part loan cancellations that were necessitated during the project. Implementing agencies could not take advantage of project funds available at the start of the fiscal year due to lack of coordination with DEA and the state finance departments. Government performance is rated Moderately Satisfactory.

66. In some cases, major construction contracts were delayed or poorly managed by the state authorities. State governments have generally not been able to provide adequate staff and operating budgets to the DSOs. However, the Borrower’s performance with accounting, financial reporting, and auditing requirements was generally satisfactory.

67. CWC did not initially perform its role in a pro-active manner and expected the states to make the first moves, especially for dam break modeling, and action plan preparation. CWC and the states were slow in agreeing on hydrological and other design parameters and in finalizing detailed designs. However, towards the end of the project, there was some improvement in coordination between the CWC and the states. Procurement of instruments and software for flood forecasting were three years behind schedule due to differences between CWC and the Bank, but was mostly completed towards the end of the project. Keeping in view the complexity of institutional relationships and logistics in interaction between the central and state levels, implementing agency performance is rated Moderately Satisfactory. Overall, Borrower performance is rated as Moderately Satisfactory.

**Lessons**

At its core, the project was an institutional development project, even though 80% of its cost went towards remedial works and basic dam safety facilities. The key lessons from the project are:
• Institution-building can be a long process when it involves organizations at multiple levels, establishing new work methods, and upgrading technical expertise. In such cases, the Bank should consider an extended commitment through a sequence of projects or through adaptable program lending (APL).

• Institutions that carry out regulatory functions require technical expertise and adequate resources to be able to function in a capable and independent manner. In this project, shortage of experienced/qualified staff and inadequate operating budgets contributed to the under-performance of the state dam safety organizations.

• When new monitoring and reporting procedures are instituted, their purpose should be made clear to all those involved, and appropriate and regular feedback should be given to those originating the data. In this project, there was little systematic analysis or feedback from higher levels on reporting emanating from the dam level, which may be affecting its quality and compliance.

• New techniques and equipment should be tailored to the existing level of capacity, facilities and funds for ongoing maintenance. A significant portion of the relatively sophisticated instrumentation installed at dams under this project has deteriorated for lack of maintenance or use.
Annex A. Basic Data Sheet

INDIA DAM SAFETY PROJECT (LOAN 3325-IN/CREDIT 2241-IN)

Key Project Data (*amounts in US$ million*)

<table>
<thead>
<tr>
<th></th>
<th>Appraisal estimate</th>
<th>Actual or current estimate</th>
<th>Actual as % of appraisal estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project costs</td>
<td>196.8</td>
<td>115.8</td>
<td>59</td>
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<tr>
<td>Loan/credit amount</td>
<td>153.0</td>
<td>92.7</td>
<td>60</td>
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<tr>
<td>Cofinancing</td>
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<td>Cancellation</td>
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Cumulative Estimated and Actual Disbursements

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<tr>
<th></th>
<th>FY91</th>
<th>FY92</th>
<th>FY93</th>
<th>FY94</th>
<th>FY95</th>
<th>FY96</th>
<th>FY97</th>
<th>FY98</th>
<th>FY99</th>
<th>FY00</th>
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</thead>
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<tr>
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<td>15.6</td>
<td>32.5</td>
<td>55.4</td>
<td>90.6</td>
<td>124.3</td>
<td>150.4</td>
<td>153.0</td>
<td>153.0</td>
<td>153.0</td>
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<tr>
<td>Actual (US$M)</td>
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<td>10.9</td>
<td>14.8</td>
<td>21.2</td>
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<td>35.0</td>
<td>50.7</td>
<td>68.9</td>
<td>85.7</td>
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<tr>
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<td>34</td>
<td>27</td>
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<td>20</td>
<td>23</td>
<td>33</td>
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Date of final disbursement:

Project Dates

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<td>PCD</td>
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<td>12/01/1990</td>
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<tr>
<td>Board approval</td>
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<td>05/14/1991</td>
</tr>
<tr>
<td>MTR</td>
<td>03/31/1994</td>
<td>12/01/1994</td>
</tr>
<tr>
<td>Closing date</td>
<td>09/30/1997</td>
<td>09/30/1999</td>
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### Staff Inputs (Actual/Latest Estimate)

<table>
<thead>
<tr>
<th>Stage of Project Cycle</th>
<th>Staff weeks</th>
<th>US$ ('000)</th>
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<tr>
<td>Identification/Preparation</td>
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<td>Appraisal/Negotiation</td>
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<td>78.8</td>
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<tr>
<td>Supervision</td>
<td>211.3</td>
<td>328.6</td>
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<tr>
<td>ICR</td>
<td>17.0 (est.)</td>
<td>60.0</td>
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<td>Total</td>
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<td>648.9</td>
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### Mission Data

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<tr>
<th>Date (month/year)</th>
<th>No. of persons</th>
<th>Specializations represented</th>
<th>Implementation status</th>
<th>Development objectives</th>
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<td>Identification/Preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>December 1990</td>
<td>7</td>
<td>E, Ec</td>
<td></td>
<td></td>
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<tr>
<td>Appraisal/Negotiation</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December 1990</td>
<td>7</td>
<td>E, Ec</td>
<td></td>
<td></td>
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<tr>
<td>Supervision</td>
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<td>Ec, EDS</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Aug/Dec 1992</td>
<td>2</td>
<td>Ec, EDS</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Apr 1993</td>
<td>1</td>
<td>EDS</td>
<td>U</td>
<td>S</td>
</tr>
<tr>
<td>Oct 93/Feb 94</td>
<td>1</td>
<td>EDS</td>
<td>U</td>
<td>S</td>
</tr>
<tr>
<td>MTR: Nov/Dec 1994</td>
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<td>EDS</td>
<td>U</td>
<td>S</td>
</tr>
<tr>
<td>Dec 1995</td>
<td>2</td>
<td>EDS</td>
<td>U</td>
<td>S</td>
</tr>
<tr>
<td>Jan/Feb 1997</td>
<td>5</td>
<td>ED, EDS, Ec, I, P</td>
<td>S</td>
<td>S</td>
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<tr>
<td>June 1997</td>
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<td>ED, EDS, Ec, P, I</td>
<td>S</td>
<td>S</td>
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<td>Jan 1998</td>
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<td>EDS, Ec, H, P, I</td>
<td>S</td>
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<td>EDS, Ec, H, P, I</td>
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<tr>
<td>Jan/Feb 1999</td>
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<td>ICR Oct/Nov 99</td>
<td>6</td>
<td>EDS, H, Ec</td>
<td>S</td>
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</tbody>
</table>

Ec: Economist  
H: Hydrologist  
S: Satisfactory  
ED: Design Engineer  
I: Irrigation Engineer  
P: Procurement Specialist  
EDS: Expert on Dam Safety  
U: Unsatisfactory

### Other Project Data

Borrower/Executing Agency:

**FOLLOW-ON OPERATIONS**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Credit no.</th>
<th>Amount (US$ million)</th>
<th>Board date</th>
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<tbody>
<tr>
<td>Dam Rehabilitation and Improvement Project (DRIP)</td>
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<td>Expected 23-Jul-2009</td>
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</tbody>
</table>
Annex B. List of Dams Visited and Organizations/Departments Consulted

List of Dam Sites Visited

<table>
<thead>
<tr>
<th>DAM</th>
<th>Province</th>
<th>Height (meters)</th>
<th>Gross Reservoir Capacity (million cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tigra</td>
<td>Madhya Pradesh</td>
<td>24.7</td>
<td>130</td>
</tr>
<tr>
<td>Pillowa</td>
<td>Madhya Pradesh</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kotwal</td>
<td>Madhya Pradesh</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gandhisagar</td>
<td>Madhya Pradesh</td>
<td>64</td>
<td>6920</td>
</tr>
<tr>
<td>Rana Pratap Sagar</td>
<td>Rajasthan</td>
<td>54</td>
<td>1566</td>
</tr>
<tr>
<td>Kota Barrage</td>
<td>Rajasthan</td>
<td>-</td>
<td>99</td>
</tr>
<tr>
<td>Hirakud</td>
<td>Orissa</td>
<td>61</td>
<td>5896</td>
</tr>
<tr>
<td>Derjhang</td>
<td>Orissa</td>
<td>27.31</td>
<td>51</td>
</tr>
<tr>
<td>Mannimuthar</td>
<td>Tamil Nadu</td>
<td>45.7</td>
<td>156</td>
</tr>
<tr>
<td>Vaigai</td>
<td>Tamil Nadu</td>
<td>33.8</td>
<td>193.8</td>
</tr>
<tr>
<td>Kodaganar</td>
<td>Tamil Nadu</td>
<td>12.8</td>
<td>12.3</td>
</tr>
</tbody>
</table>

Offices/Departments Consulted

Government of India

National Planning Commission (Water Resources)
Ministry of Water Resources (Policy and Planning)
Central Water Commission (Dam Safety, Hydrology)

States
Public Works Department, Government of Tamil Nadu
Department of Water Resources, Government of Orissa
Department of Water Resources, Government of Madhya Pradesh
Department of Irrigation, Government of Rajasthan

Dam Safety Directorate, Government of Tamil Nadu
Dam Safety Organization, Government of Orissa
Dam Safety Cell, Government of Madhya Pradesh
Dam Safety Organization, Government of Rajasthan

Staff of Dam Safety Units in the Governments of Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu.
Chief Engineers/Executive Engineers, dams site Staff at each dam site.

World Bank

Project Task Team
South Asia Sustainable Development Division, World Bank, Washington D.C.
Annex C. Borrower’s Comments

Dalip Kapur
Under Secretary (MI)
Tel. No. 23095515

D.O. No. 4/11/91-FB II
Government of India
Ministry of Finance
Department of Economic Affairs

New Delhi, 15th June, 2000

Dear Ms. Huppi,

Kindly refer to your letter dated 21st April, 2009 regarding the Project Performance Assessment Report of the “Dam Safety Project (Credit No. 2241; Loan No. 3325)”.

2. A copy of the comments on the PPAR received from Ministry of Water Resources is enclosed.

With regards,

Yours sincerely,

(D.Signed)

Encl. 2 pages

Ms. Monika Huppi,
Manager,
Sector Evaluation Division,
Independent Evaluation Group,
World Bank,
1818 H Street N.W.,
Washington, D.C. 20433,
United States of America
Fax: 202-623-1234
<table>
<thead>
<tr>
<th>SN</th>
<th>Comments in PPAR pertaining to CWC</th>
<th>Observation of CWC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The capacity of the Central Water Commission (CWC), the main implementing agency and the State Dam Safety Organizations (DSOs) was enhanced through training and involvement in project activities. Officials of the central and state governments, the CWC, and the DSOs reported that the project increased their awareness of dam safety issues and improved capacity to diagnose and prioritize problems. But the depth of this understanding appears to be uneven across different levels of the government. Basic dam safety facilities including instrumentation that were installed under the project were not backed up with sufficient ongoing maintenance and user training, resulting in only a marginal impact.</td>
<td>Overall capacity of CWC was enhanced and gained useful experiences due to this project. Limitations indicated have been noted for future compliance.</td>
</tr>
<tr>
<td>2.</td>
<td>The CWC needs to play a stronger role in advocating for dam safety, upgrading and sharing its expertise, and improving coordination with DSOs.</td>
<td>DSO, CWC is already working in this direction.</td>
</tr>
<tr>
<td>3.</td>
<td>However, the Bank was optimistic about the time required to establish and build new institutions for dam safety in the states, and overestimated the capacity of CWC to coordinate project implementation.</td>
<td>The issues involved have been examined. Remedial actions will be undertaken during DRIP implementation.</td>
</tr>
<tr>
<td>4.</td>
<td>The CWC was designated as the main implementing agency and its Dam Safety Organization as the focal point for implementing the project. The lack of constitutional authority and legislation for CWC to enforce a national program of dam safety assurance was recognized as a problem, but the project did not address its implications sufficiently.</td>
<td>The National Dam Safety Act, which is under process of enactment may address the issues of constitutional empowerment of central/state dam safety organizations.</td>
</tr>
<tr>
<td>5.</td>
<td>Institutional strengthening at CWC’s Dam Safety Organization was affected due to tardiness in redeploying staff in the unit, with the result that the full staff complement was in place only during the extended project period. Frequent rotation of staff required increased training efforts at CWC as well in the four project states.</td>
<td>Remedial actions will be undertaken during DRIP implementation.</td>
</tr>
<tr>
<td>6.</td>
<td>The project contributed to the Dam Safety Organization and the Hydrology Organization in the CWC by providing equipment and training. Training for CWC during the project included study courses, workshops, seminars, and 38 man-months of study tours and training abroad. This served to improve CWC’s capacity to review hydrology, prepare Probable Maximum Precipitation (PMP) atlases, design flood computation procedures, prepare models for operation of gated spillways, carry out dam break analyses, and prepare guidelines for emergency procedures. But the impact of training during the project may have been reduced to some extent due to retirements and turnover of staff, and relatively little follow-up training.</td>
<td>Remedial actions will be undertaken during DRIP implementation.</td>
</tr>
</tbody>
</table>
7. State and dam site officials largely agree that CWC is generating important and timely data for decision-making. But officials of both the CWC and the state government were not able to provide a clear explanation as to why they were not able to integrate this data with better operating rules for dam operations. In particular, the project missed a clear opportunity to fully study the possible ways of dealing with the revised design flood at the Gandhisagar—a dam of national importance—and at its downstream cascade of dams. Remedial actions will be undertaken during DRIP implementation.

8. Substantial progress has been made in the institutional strengthening of CWC's DSO and Hydrology organization, and in improving flood forecasting facilities. But there was only modest improvement in the technical capabilities of Dam Safety Committees and state DSOs. Remedial actions will be undertaken during DRIP implementation.

9. Most project components encountered delays to different extents. Remedial works were delayed due to lack of preparation while basic dam safety facilities were delayed due to delays in procurement and mobilizing contractors at scattered locations (see section on Implementation). Procurement and installation of novel instruments and dedicated software for flood warning systems was more than three years behind schedule due to differences between the CWC and the Bank on design modalities and on deployment of staff. Final project costs appear commensurate with the revised targets for remedial works. Remedial actions will be undertaken during DRIP implementation.

10. However, records indicate that the CWC does not have up-to-date and comprehensive data on the safety status of dams. Further, the states do not consistently report problems or dam failures to the CWC. Hence the value of CWC's informal assessment on the overall dam safety in the country is limited. Remedial actions will be undertaken during DRIP implementation.

11. Many state officials feel that the CWC's role in being an advocate for dam safety at the highest level, sharing its expertise with the states and helping to build their capacity is not up to expectations. At the same time, the states do not always seem to be inclined to seek CWC's expertise even in areas where it has a clear edge such as hydrology and basic dam safety facilities. A clear opportunity for synergy between the CWC and the states is being underutilized. Remedial actions will be undertaken during DRIP implementation.
Office of the Director,  
Support Services & Dam Safety,  
Secha Sadan, Unit-V, ORISSA, Bhubaneswar-01.  
Tele-Fax – (0674) -2531934, E-mail : damsafety_orissa@yahoo.co.in

To

Monika Huppi,  
Manager,  
Sector Evaluation Division,  
Independent Evaluation Group.  
kmhuppi@worldbank.org  
Rjammi@worldbank.org

Sub:- India – Dam Safety Project (Credit No.2241, Loan No.3325) Project Performance Assessment Mission.

Sir,

The draft report of the above mentioned mission has been gone through and there is no comment except a correction at Page 21. The height of Derjang Dam in Orissa state may be corrected as 27.31m instead of 144.8 m. The draft report reached the undersigned late. Hence the comments could not be communicated within stipulated time.

Yours faithfully,

DIRECTOR, S.S. & D.S.

Memo No. /Dated the

Copy submitted to Sri M.K.Verma, IAS, Joint Secretary to Government, Department of Water Resources, Orissa, Bhubaneswar for favour of information with reference to DOWR letter No.15991 dated 02.06.2009.

DIRECTOR, S.S. & D.S.