

DAM REHABILITATION AND IMPROVEMENT PROJECT – THE NEW INITIATIVE FOR DAM SAFETY IN INDIA

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ABSTRACT

The DAM REHABILITATION AND IMPROVEMENT PROJECT (DRIP) is being taken up with the World Bank assistance for implementation initially in four States – namely Kerala, Madhya Pradesh, Orissa, and Tamil Nadu – and in Central Water Commission. Few more States are expected to join DRIP at a later stage, for which a provision of unallocated resources has been provided for in the project estimate. The project presently targets for rehabilitation of 223 dams in the four States; and with the participation of some more States, the number of rehabilitated dams may touch the 300 mark. In addition, the project also aims for the dam safety institutional strengthening in the participating States and in Central Water Commission. The main implementation agencies for DRIP will be the owners of dams – i.e. Water Resources Departments and State Electricity Boards in the participating States. The overall implementation of the project will be coordinated by Central Water Commission with assistance of an engineering and management consulting firm. DRIP, with an estimated cost of Rs. 2100 crore, will be implemented over a period of six-years starting from April 2012.

DRIP – Government of India's new initiative for dam safety in India – was preceded by another World Bank funded project called 'Dam Safety Assurance and Rehabilitation Project (DSARP)', which was implemented during the period 1991-99. This paper examines the scope of DRIP in the backdrop of outcome achieved by DSARP. The paper also describes the present status of DRIP, and the strategic approach being adopted for overcoming the deficiencies encountered in DSARP implementation.

1. INTRODUCTION

Dams are critical components of the infrastructure in India. The approximately 5125 large dams (4728 completed and 397 under construction) and several thousand smaller dams provide a range of economic, environmental, and social benefits, including hydroelectric power, irrigation, water supply, flood control, and tourism. However, like all pieces of infrastructure, dams age and deteriorate, posing a potential threat to life, health, property, and the environment. Although, in India a sound foundation was laid for a nation-wide systematic dam safety surveillance programme in 1979, and maintenance and upkeep of the dams have been started recognizing dam safety as an important activity, significant funds are not provided for dam safety rehabilitation.

In most of the States, budget allocations for maintenance of irrigation projects, including dams, are made on the basis of hectare as a unit under the project command area. This type of budgeting procedure is generally not equitable and sufficient for the dams. As a result, only annual inspections and routine repairs are generally carried out within the framework of budget allocations. Moreover, with the increase in water resources development activities in the States for creating additional irrigation potential, surveillance and maintenance of dams have started getting even lower priority in respect of allocations of funds. Thus, many dam owners are

unable to undertake dam repairs and rehabilitation due to lack of funding. This situation often results in dangerously neglected and deteriorated dams. Given the number and widespread distribution of dams in India, it is clear that the affected populations and sectors are many, and that the effects of dam-related hazards can be very serious. Evidently, allocations for dam O&M need to be more in line with need-based assessments. But India has yet to adopt modern asset management planning to guide the efficient operation and, especially, maintenance of dams.

In view of above and the largely ageing profile of Indian dams – about 76% of them over 20 years old – action is urgently required to:

- Ensure rehabilitation and modernization of dams to bring them back to full standard of safety and operation;
- Develop and implement adequate O&M programs;
- Ensure regular review of the status of the dams, both by the operator and by independent review panels, to examine problems relating to sustainable O&M of dams; and
- Formulate standards and guidelines and asset management systems to minimize future risks of dam failures.

2. INITIAL DAM SAFETY EFFORTS

Realizing the importance of dam safety, Govt. of India had very early taken a number of steps to reinforce its concerns. As a consequence, Dam Safety Organization was created in Central Water Commission (CWC) during June, 1979 for assisting states in evaluating safety-related hazards in existing structures. Subsequently, 14 states having significant no. of dams have also established their own Dam Safety Organization and have taken up measures for ensuring dam safety in their respective jurisdictions. The Ministry of Water Resources, having realized that the paucity of resources in Non-Plan sector was one of the main hurdles in the way of making dam safety activity more effective, decided that a dam safety assurance program, including strengthening of organizations, should become a part of planned activity from the beginning of 8th Five Year Plan. As a result, Dam Safety Assurance & Rehabilitation Project (DSARP), assisted by the World Bank, was implemented in four States of the Indian Union – namely Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu – under overall guidance of CWC during the period 1991 to 1999. The Project was completed in September 1999 at a cost of Rs. 422.95Crore. The project objectives of DSARP were to:

- Improve the safety of selected dams in the project states through remedial works;
- Install basic dam safety-related facilities; and
- Strengthen the institutional framework in CWC and project states responsible for assuring dam safety.

In DSARP, institutional set-up at the Centre in CWC as well as in the four participating States was strengthened through training of officers, purchase & installation of modern equipments etc. Formulation and use of a number of guidelines on dam safety, and preparation of Probable Maximum Precipitation (PMP) Atlases by CWC with assistance from the implementing agencies and dam owners, have been the most significant and unique achievements of the project. With the use of PMP Atlases, the uniformity in methodology/ approach for the estimates of appropriate precipitation values in the various regions was achieved. 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. Basic dam safety facilities like providing access roads, backup power, instrumentation, installation of communication system, stockpiling of emergency material, etc., was provided at 182 dam locations in the 4 States.

In 33 dams (out of 55 dams that were proposed at the start of the project) remedial measures were completed under DSARP and they have come up to the desired safety level, reducing the risk and adverse environmental impact on the property and people living downstream. Thus, probable loss of reservoir capacities was restored to provide for assured irrigation/ water supply/ power generation which in turn have contributed to the economic development of the respective regions in the country. Remaining rehabilitation works of the balance 22 dams were also completed subsequently by the four State Governments through their own funds. The key outcomes of the dam rehabilitation activities under DSARP are summarized in Table-1.

Table-1

Key outcomes of the dam rehabilitation activities under DSARP

Outcome	No. of Projects where outcomes were accomplished				
	Tamil Nadu	Orissa	Rajasthan	M.P.	Total
Number of DSARP dams	15	11	11	18	55
Revision of design flood	12	9	11	13	45

Enhancement of Spillway capacity to pass design flood	4	8	11	4	27
Remedial measures for distress conditions , if any	5	8	7	13	33
Comprehensive dam safety assessment	0	11	11	10	32
Preparation of Emergency Action Plan	0	0	11	5	16
Operation Manual	0	4	11	9	24
Enhancement of basic facilities	15	9	11	11	46
Training of Dam Operation and Maintenance staff	0	0	11	3	14
Improvement in inflow forecasting	0	1	0	2	3
Dam Instrumentation	15	3	3	0	21

The DSARP has also helped in streamlining data collection at the dam level through standardizing pre- and post-monsoon reports. The capacity of the CWC (the main implementing agency) and the State DSOs was enhanced through training and involvement in project activities. The project increased the awareness of dam safety issues, and improved capacity of implementing agencies to diagnose and prioritize problems. However, the DSARP was a unique project – being first of its kind anywhere in the world – and this has also made it a difficult project.

For the first time in India a systematic procedure for dam safety, based on international practices, was sought to be introduced through this project. The elaborate procedure called for mandatory seasonal inspections, Phase-I inspections, safety evaluations, Phase-II investigations, review by the State Dam Safety Committees (SDSC) and prioritizations, selection of suitable consultants for investigations, design and execution of remedial works, and approval by the independent Dam Safety Review Panels (DSRP) at various stages. As this new process was time-consuming due to inherent problems, some time was lost in fulfilment of these requirements. There was a slow pace in the early project period which had delayed finalisation of remedial measures and consequent delay in tendering for remedial works. The mandatory dam safety procedures particularly Phase-I inspection and Phase-II investigations and review of hydrology and finalisation of design floods of selected dams caused considerable delay in commencing remedial works. Considerable time was also spent in identifying and selecting competent consultants and finalising designs for remedial works. Problems were also compounded owing to such limitations as: inadequate placement of adequate staff and their frequent transfers – which also made any amount of training redundant; confusion regarding roles and responsibilities of multiple agencies and absence of a proactive action on their part; delays in financial approvals and provision of budgets for counterpart funding.

Despite above performance linked setbacks, DSARP was considered as a successful project. Moreover, the experience gathered during its implementation added immense value to India's dam safety learning curve; and the key lessons from the project are summarized as under:

- Institution-building can be a long process when it involves organizations at multiple levels, establishing new work methods, and upgrading technical expert.
- 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.
- 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.

3. DAM REHABILITATION AND IMPROVEMENT PROJECT (DRIP)

Implementation of DSARP had provided an impetus for further work in the area by creating awareness about dam safety concepts and benefits of their adoption. Accordingly, it was decided to extend the dam safety activities, and DSARP Phase-II was thus conceived in year 2000 which initially included 13 States having significant numbers of large dams. The DSARP Phase-II was later (in year 2005) rechristened as Dam Rehabilitation and Improvement Project (DRIP). However, substantial delays were encountered in shaping of the final project proposal which also saw veining of interests from some of the States. The present form of DRIP (agreeable to World Bank, CWC and States) was negotiated in year 2010 and as per which the project would be

implemented in four States – namely Kerala, Madhya Pradesh, Orissa, and Tamil Nadu – with funding assistance from the World Bank. About 223 large dams in the four participating states with substantial need for rehabilitation and improvements would be included in the project. Some more states may join DRIP at a later date for which provisions have been made in the DRIP estimate; and thus the total number of dams likely to benefit from the project would be around 300. DRIP will be spread over a period of six years. The loan/ credit agreement has already been signed with the World Bank, and the project is likely to become effective from April 2012.

3.1 Objectives of DRIP

The project development objectives of DRIP are to:

- Improve the safety and performance of selected existing dams and associated appurtenances in a sustainable manner, and
- Strengthen the dam safety institutional setup in participating States as well as at Central level.

The objectives of DRIP are to be achieved through investments for physical and technological dam improvements, managerial upgrading of dam operations, management and maintenance, with accompanying institutional reforms. This will in turn help to keep dams safe, respond to changing water demands, and keep the downstream population safe from floods. DRIP would also aim at restoring the capacity of project dams for effective utilization of the stored water, and monitoring and managing the long-term performance of the dams. Further, it is expected that the institutional development activities will lead to an improvement in the system-wide management approach to all dams in the participating states, over and above the focus on the selected dams covered by the project. The project will thus address dam system management in a holistic manner.

3.2 Profile of DRIP Dams

The selection of 223 dams for DRIP has been made by the states concerned. The states have done a review of the status of their dams and have determined those dams that are most in need of rehabilitation and improvement in order to guarantee their future safety and operational capacity. Kerala has proposed 54 dams, out of which 19 dams are managed by the Water Resources Department (WRD) and 12 dams managed by the Kerala State Electricity Board (KSEB). Some of these dams are in reality dam complexes, with more than one dam body. However for the purposes of DRIP, such complex is considered as one dam. Tamil Nadu has proposed 104 dams to be included in DRIP, of which 68 dams are managed by the WRD and 36 by the Tamil Nadu Electricity Board (TNEB). The number of dams from Madhya Pradesh and Orissa are 50 and 38 respectively. The State-wise coverage of DRIP is given in Table-2 below:

Table: 2

Coverage of Dam Rehabilitation & Improvement Project

State	Number of large dams in the State	Number of dams Proposed under DRIP	Percentage coverage of DRIP
Kerala	54	31	57.40%
Madhya Pradesh	906	50	05.52%
Orissa	163	38	23.31%
Tamil Nadu	108	104	96.29%
Total	1,231	223	18.12%

Most DRIP dams are single purpose, either for irrigation or for hydro-power, but some are used for both and some also for potable water supply or flood control. It can be observed from the age-wise profile of DRIP dams given in Figure-1 that the majority of the dams (around 59%) are 25 to 50 years old, while only 4 dams (around 2%) are over 100 years old. Figure-2 depicts the type-wise distribution of DRIP dams, and it can be seen that earthdams predominate the list comprising 56 % of all DRIP dams, while the only arch dam in the country

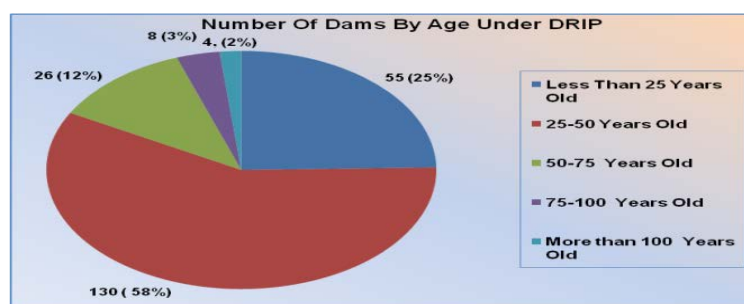


Figure-1: Age-wise Profile of DRIP Dams

(i.e. Idukki dam) is also included in the DRIP. The height-wise profile of DRIP dams is shown in Figure-3, and it is evident that majority of dams (around 50%) are in the height range of 15 to 30 m, and there are 4 dams (around 2%) that are more than 100 m high.

Many of DRIP dams are facing various structural deficiencies as well as shortcomings in operation and monitoring facilities, and thus affecting the safety of the structures and the life and properties in and around the dam. Many of these dams were built based on the prevalent empirical formulae and found to be inadequate based on the current design standards and philosophy. The typical commonly observed problems include: (i) seepage boils and leakage downstream of earth dams; (ii) deformity and erosion of upstream and downstream slopes, erosion of abutments and settlement and cracks along dam crests; (iii) under-designed spillways; (iv) excessive seepage through masonry dams; (v) cracks and pitting in concrete and masonry spillways and outlet gate structures and erosion of energy dissipation systems and spill channels; (vi) deficiencies in gates and hoisting system; and (vii) malfunctioning of dam monitoring instruments.

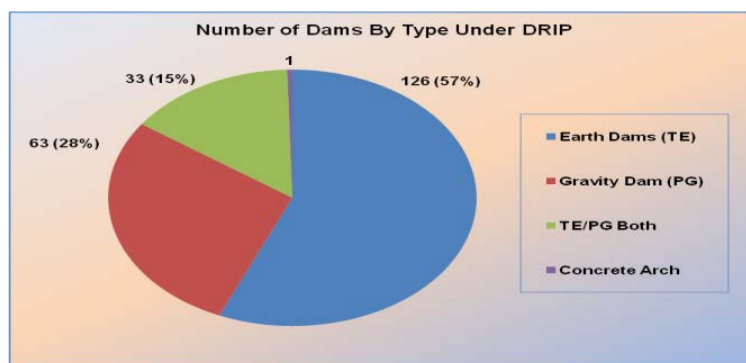


Figure-2: Type-wise Profile of DRIP Dams

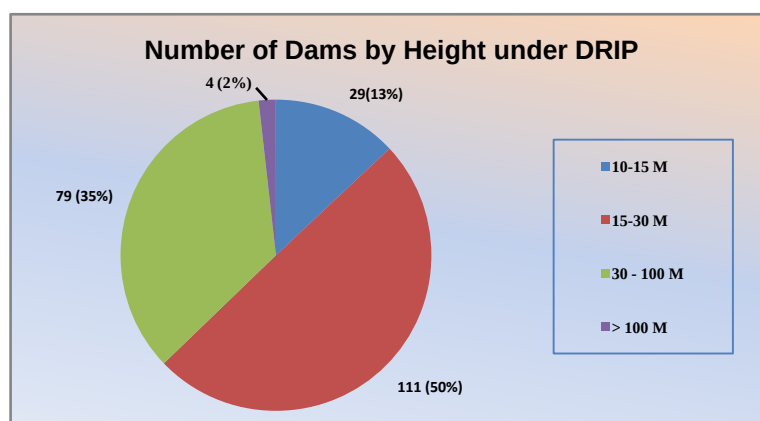


Figure-3: Height-wise Profile of DRIP Dams

3.3 Project components

The overall framework of project involves three components, which are:

- Rehabilitation and Improvement of Dams and Associated Appurtenances:
- Dam Safety Institutional Strengthening
- Project Management

3.3.1 Rehabilitation and Improvement of Dams and Associated Appurtenances:

The rehabilitation and improvement of identified large dams would be affected by focusing on structural and non-structural measures at the dams, hydrological assessments, sediment management, and other measures required to improve the safety and operation of the dams and associated appurtenances. Support would also be provided, as needed, for the preparation of asset management plans, emergency preparedness plans, emergency warning systems, floodplain mapping, and downstream impact mitigation measures.

The structural aspects of dam rehabilitation and improvement proposals are expected to include, but not be limited to, such works as:

- Treatment of leakage through masonry and concrete dams and reduction of seepage through earth dams and their foundations;
- Improving dam drainage;
- Structural strengthening of dams to withstand higher earthquake loads and flood water levels;
- Remodeling earth dams to safe, stable cross-sections;
- Improving toe drains and seepage measuring devices;

- Improving the ability to withstand higher floods, including additional flood handling facilities, if needed;
- Repairs to damaged spillways, stilling basins and downstream channels;
- Improving approach roads, dam crest roads and roads for access to other parts of the dam;
- Improving dam safety instrumentation;
- Improving communications – as much as possible real-time - between dams and upstream rain and river flow gauging stations and with other dams and control offices, as well as with civil authorities in flood plains downstream of the dam;
- Flood marking;
- Provision of low-voltage electrical supplies in inspection and drainage galleries of dams;
- Improving lighting for external areas of dams;
- Provision of standby generators for emergency operation of spillway gates;
- Completion of works that should have been done when the dam was commissioned;
- Provision of inspection launches;
- Rehabilitation and improvement of spillway, head regulator and draw-off gates and their operating mechanisms; and
- De-silting of reservoirs (expected only in few cases).

As per the findings of the International Commission on Large Dams, approximately one third of the failures are direct result of flood exceeding the capacity of the spillway. The examination of the flood handling capacity for existing dams and spillways is therefore, a vital component of any comprehensive dam safety assurance program. Many dams, especially the older ones, have computed design floods that are inadequate according to the new standards. The statistics from the revised design flood studies carried out for some of the Phase-I DRIP dams confirms this view. Out of 28 projects reviewed so far, flood handling capacity of only 5 projects (i.e. 17.86%) is found to be adequate. In balance 23 projects the increase in revised design floods is also a cause of concern with 8 projects (about 35%) showing an increase beyond 100%, while 13 projects (about 57%) show an increase of over 50% (Table-3 and Figure-4).

Table-3

Revised Design Flood Studies of DRIP Dams

Increase in design flood	No. of Dams	Cumulative No.	Percentage
> 100%	8	8	34.78
75-100%	1	9	39.13
50-75%	4	13	56.52
25-50%	4	17	73.91
00-25%	6	23	--
Total projects of inadequate flood capacity:		23	
Projects of adequate design flood capacity :		05	
Total No. of Projects:		28	

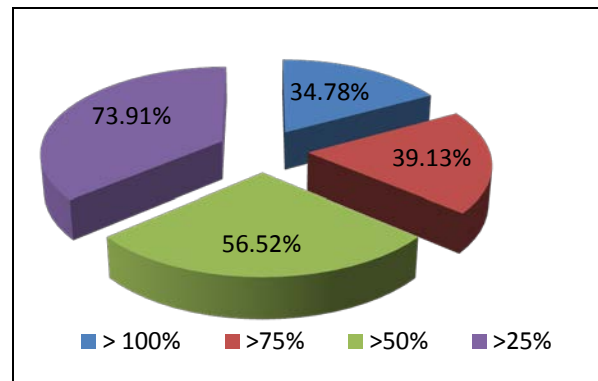


Figure-4: Range of Increase in Design Floods

Under DRIP, before any rehabilitation and improvement works are undertaken on a dam, the design flood for the reservoir shall be calculated in accordance with IS-11223, using the most appropriate available data. This calculation would require the approval of CWC. The rehabilitation works and operational procedures (non-structural methods of coping with design floods) proposed under DRIP would ensure the safety of dam and reservoir with this design flood.

Owing to topographical and/or structural constraints, it is often found difficult to increase the capacity of an existing spillway to suit the revised design flood. In such cases, routing trials can be carried out for identification of lower reservoir levels during the flood season. Even this, in some cases, is found to be costly and unviable in terms of loss of power and irrigation benefits. Other options that can be considered for the safe operation of the reservoir include: (a) pre-release of water at maximum rate on 24-hour warning of a flood; (b) lowering the spillway crest level and using fuse gates or other spillway control systems; (c) building flood control retention basins upstream; (d) developing an emergency action plan; and (e) controlled overtopping of the dam. For each dam under DRIP the best option for the safe release of floods will have to be determined. Every dam will also need a new or updated Reservoir Operational Manual that reflects the developed solutions. A comprehensive warning system would be put in place, and an awareness campaign would be conducted, in accordance with the emergency action plan.

Before any rehabilitation and improvement works are undertaken on a dam in DRIP, the stability of the dam shall be checked using the latest seismic parameters applicable to the location of the dam. The works proposed under DRIP would ensure dam and reservoir safety under the specified seismic conditions. However, it will not be considered a necessity to carry out separate studies for the formulation of 'site specific seismic parameters' of the identified dams. To the extent available, inputs from studies carried out for recently constructed dams in same geological location shall be taken in to consideration for finalization of the seismic parameters of DRIP dams.

The health of existing instruments, if any, would be reviewed. To the extent necessary and practicable the faulty instruments will be replaced, and additional instruments will also be provided. Appropriate system will be put in place for record-keeping and analysis of such instrumentation data. For each dam included in DRIP a comprehensive history of the dam would be compiled during the time of design of the interventions, including a description of construction problems, geological conditions, as-built drawings, design calculations, details of any modifications made, and records of performance, including inflows and outflows, reservoir levels, rule curves, seepage, leakage, movement, settlement and pore pressures.

3.3.2 Dam Safety Institutional Strengthening:

This component will be focusing on regulatory and technical frameworks for dam safety assurance in participating States as well as at Central level. The activities to be carried out will include, but not be limited to:

- Targeted training nationally (especially at the National Water Academy in Pune) and internationally to Dam Safety Organizations in CWC and States to make them effective organizations that can take lead in ensuring safety of dams from structural and operational point of view;
- In-country and external training of staff of WRDs and SEBs to assist with the development of appropriate skills and modern tools to adequately operate and maintain dams;
- Attendance at dam safety courses, study tours, and linking with foreign country agencies that have advanced dam safety programs such as Canada, United States, and Switzerland;
- Operation of independent dam safety review panels, comprising experts in relevant disciplines;
- Development of capacity to carry out reservoir sedimentation studies;
- Development of Management Information Systems (MIS) and other programs to capture and analyze data for long-term planning and guiding of dam operations;
- Support to the further development within CWC of the Dam Health and Rehabilitation Monitoring Application (DHARMA) program that will allow a systematic presentation and interpretation of data for effective monitoring of the health of dams;
- Support to the revision of existing guidelines on dam safety and preparation of new guidelines, as needed; and
- Training in hazard and vulnerability assessment and dam-break analysis.

3.3.3 Project Management:

The main implementation agencies for DRIP will be the owners of dams (i.e. Water Resources Departments (WRD) and State Electricity Boards (SEB)) in the participating States. The existing State level Implementing Agencies (IAs) are as under:

- Kerala Water Resources Department
- Kerala State Electricity Board
- Madhya Pradesh Water Resources Department
- Orissa Surface Water Resources Department
- Tamil Nadu Water Resources Department
- Tamil Nadu Electricity Board

The DRIP implementation by IAs will be carried out in accordance with the project implementation plan, containing, inter alia, specific provisions on detailed arrangements for the carrying out of the Project, including the procurement, financial management and disbursement requirements, the Environmental and Social Management Framework (ESMF) and the Governance and Accountability Action Plan (GAAP). The day-to-day coordination and management of DRIP at State level will be provided by the State Project Management Unit (SPMU) established in the State Dam Safety Organization (SDSO) of each State.

For the overall coordination and supervision of DRIP, a Central Project Management Unit (CPMU) has been established in CWC. The CPMU, headed by a Project Director would have overall responsibility for project oversight and implementation – and, for this intent CPMU would be strengthened by an Engineering and Management Consulting Firm.

3.4 Cost Estimate of DRIP

The total estimated cost of DRIP is Rs. 2100.00 Crore (i.e. US\$M437.50, applying a conversion rate of 1US\$=Rs.48) with the break-up as detailed in Table-4 below:

Table-4
Break-up of Cost Estimate of DRIP (in Rs. Crore)

State	Rehabilitation and improvement	Institutional Strengthening	Project Management	Total Base Costs	Contingencies	Total Project Cost
Kerala	202.42	34.51	13.01	249.94	30.05	279.98
Madhya Pradesh	260.54	10.03	7.20	277.78	36.77	314.54
Orissa	106.37	14.35	10.27	130.99	16.75	147.74
Tamil Nadu	604.66	23.23	20.11	648.00	97.49	745.49
CWC		26.3	89.42	115.73	16.27	132.00
Unallocated Resources						480.24
Total	1173.98	108.43	140.02	1422.43	197.33	2100

Out of the total project cost, Rs. 1487.23 Crores (US\$M 309.84) is the State component for four states and Rs. 132.00 Crore (US\$M 27.50) is Central component for CWC. In addition, a provision of Rs.480.24 Crores (US \$M 100.05) has been included in the total project cost as unallocated resources that can be used during implementation for similar works in some more States which may join the project at a later date. Out of the total project cost, 80% (i.e. Rs.1680.00 Crore / US\$M 350.00) will be funded by the World Bank (50% to be provided as credit through IDA and 50% as loan through IBRD), while 20% (i.e. Rs. 420.00 Crore / US\$M 87.5) will be borne by respective State governments and CWC. The project-component-wise distribution of DRIP cost is illustrated in Figure-5.

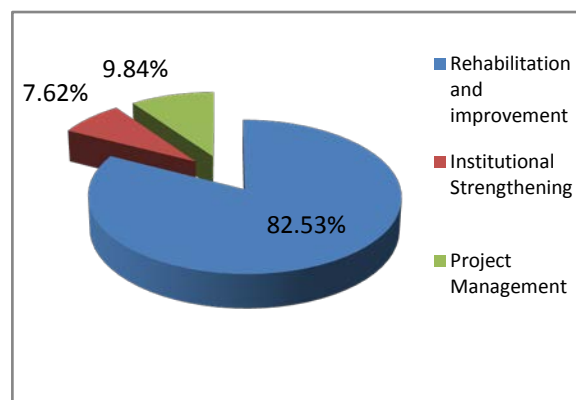


Figure-5: Component-wise Distribution of Cost

4. DRIP IMPLEMENTATION ARRANGEMENT

The State Dam Safety Organizations (SDSO), through the SPMUs, will monitor the physical and financial progress, and summarize the implementation of the progress and submit reports to the CPMU in a format generated for the Management Information System (MIS). The SDSOs will coordinate the work of Chief Engineers (CE) of the WRDs and SEBs. The Executive Engineers (EE) of WRD and SEB, under the supervision of CEs, will be responsible for preparing detailed designs and bidding documents. The offices of the CEs will have to obtain the approval of these from SDSO and CWC, and the World Bank only as necessary for complicated rehabilitation proposals. The EEs who are based in the district or zone where a project dam is located will be responsible for procurement and the execution of the works. Day-to-day construction supervision will be conducted by the EE and his staff and direct quality assurance of the works will be ensured

through WRDs' quality control units. Third-party construction supervision and quality control arrangements will be put in place through CPMU.

Before taking up rehabilitation works at any project, a standard template form will be required to be filled by the concerned EE, under the supervision of the CE, during the investigation and preliminary design stage for each dam. The template will provide the basic parameters of each dam, and detailed information on technical, environmental, social, and all implementation-related aspects. Based on this template and additional information, as needed, the SPMU will provide for a first-level screening of each dam and the proposals for its rehabilitation. The template will allow an early identification of those dams with complicated features and/or where major issues can be expected, and based on the review of the templates a final categorization of each of the dams will be made. Those that have no major technical, environmental, or social issues can have the designs finalized and tendered. Those that are complicated or where there may be major issues will require a detailed site inspection and preparation of detailed technical reports and site-specific environmental assessments (EA) and environmental management plans (EMP). Additional supervision efforts for these dams will be made available, both through CPMU and the World Bank Task Team.

In order to ensure environmental and social compliance of the activities envisaged under the DRIP, an Environmental and Social Management Framework (ESMF) has been developed for use as a reference document in the dams under rehabilitation, to take care of the environmental and social concerns. The ESMF identifies the potential environmental and social impacts of possible dam rehabilitation activities, the possible mitigation measures, and the responsible entities for implementation of the mitigation measures and their monitoring. The ESMF will be used for screening of all project dams to be able to segregate them into low, medium, and high categories in terms of their potential social and environmental impacts. This categorization will facilitate appropriate management decisions for each project dam.

The CPMU will be charged with the overall coordination of the project activities and the liaison with the states. In particular, the CPMU will provide support to SDSOs and their SPMUs and facilitate and guide the implementation and monitoring of project activities, ensuring synergy and coordination among activities and state-level agencies implementing these activities, facilitating training and knowledge sharing, and preparing consolidated progress and other project reports. Figure-6 schematically presents the works of CPMU which will be accomplished through the services of an Engineering and Management Consultancy firm. The Consultancy firm would be required to provide at CPMU a team of expert consultants, including technical and non-technical manpower, and all resources necessary for meeting the Consultancy objectives. The Consultant would also establish sub-units in each participating State and provide therein adequate technical and non-technical manpower for coordination of work between CPMU and SPMUs.

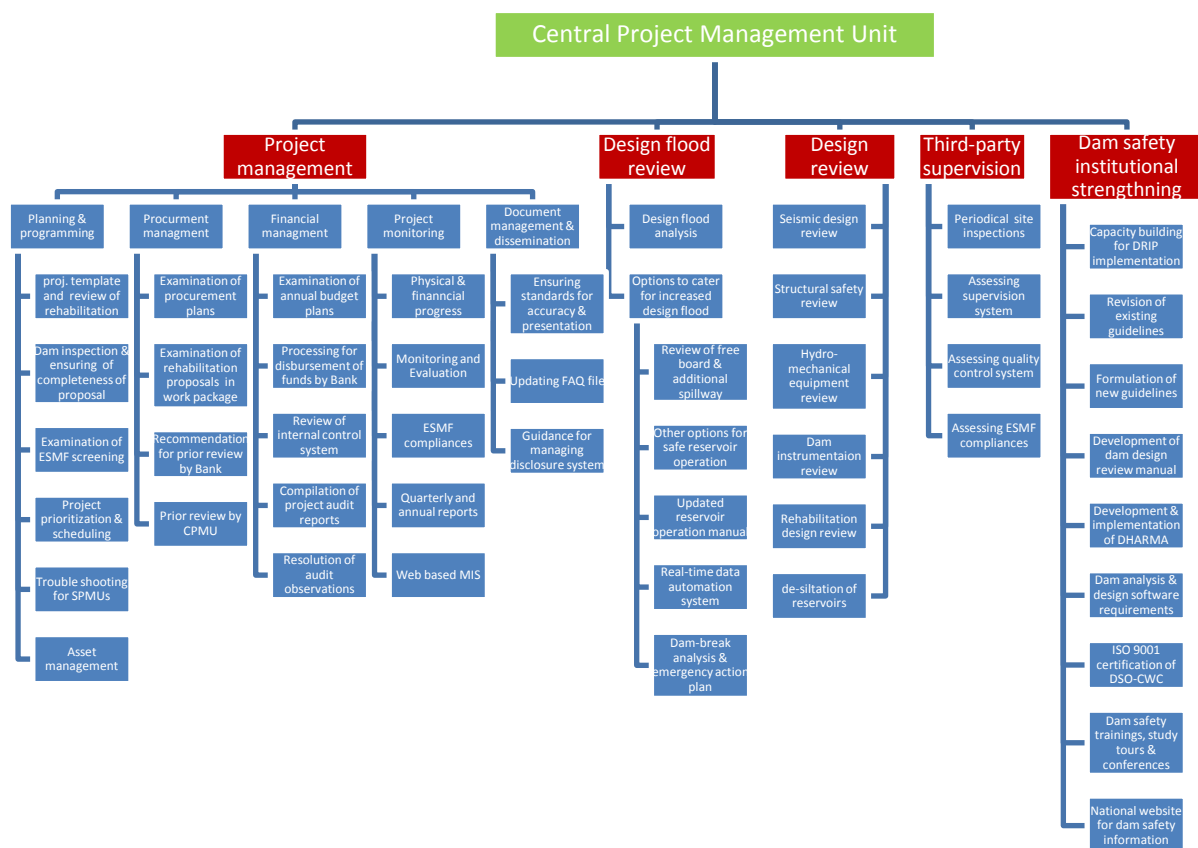


Figure-6: Schematic Diagram of Works of CPMU

A National Level Steering Committee (NLSC), headed by the Secretary Ministry of Water Resources, and including senior representatives of CWC and participating states, would broadly oversee the implementation of DRIP. A separate Technical Committee (TC) would also be in place to provide technical input to NLSC, coordinate with implementing committees of respective state governments, and review progress of projects. The TC chaired by Member (Design & Research) of CWC would also include Engineer-in-Chiefs of WRDs and SEBs of the participating states. The NLSC and TC will provide strategic supervision and directions for the successful implementation of DRIP, including the provision of a platform for dispute resolution at any time during project implementation.

5. STRATEGIC APPROACH FOR DRIP INITIATION

Planning Commission of India, while according in principle approval for DRIP during May 2000, has commented upon the setbacks in performance of Phase I Project (DSARP). They also observed that the new project should be on the basis of the findings / evaluation of the Phase I project to take care of the constraints and deficiencies found in the implementation necessitating 2 years extension as well as erratic pace of expenditure. Necessary actions were accordingly taken, and lot of preparation has thus gone into DRIP formulation and firming-up of the final proposal.

Some of the key strategies adopted for successful initiation of DRIP are summarized as under:

- For facilitating sufficient resources for a proactive role of CWC, provision has been made for hiring the services of an Engineering and Management Consultancy Firm to assist CPMU in overall project oversight – the process for hiring of consultancy firm was taken up in advance, and the consultant is now expected to be in place within six months of the project effectiveness.
- Training programs with focus on Phase-I DRIP implementation were initiated well in advance for building up in-house technical capabilities of participating states.

- The CPMU was established in CWC at a very early stage, and the participating states have also formed the respective SPMUs.
- The nodal officers for DRIP implementation have been identified by CWC and states; and efforts are being made for minimizing the rotational transfers in case of CPMU and SPMUs.
- An early startup was ensured for the hydrology reviews of Phase-I dams, and CWC has already cleared the reviews of 28 dams out of 38 Phase-I project dams (about 74%).
- All financial approval formalities in respect of DRIP have been accomplished before project effectiveness, and the availability of counterpart funding is being assured right from the commencement of the project.
- Flexibility has been incorporated in the approved scheme for effecting need based changes in the list of DRIP dams or for inclusion of additional dams from within the DRIP States.
- On completion of works on any DRIP dam, the regular maintenance and safety of rehabilitated and improved dams would be required to be done by the states from their own resources; and towards this intent, the “percentage of required budget per state for adequate O&M of dams” has been included as one of the Key performance indicators to measure achievement of Project Development Objective.
- Rather than having the O&M funds for dams incorporated in overall budgets for irrigation system O&M, it is agreed in the very beginning by all DRIP States to include a separate budget line item for all large dams in the overall budget of the Water Resource Departments and State Electricity Boards.
- With a view of long term sustainability, provisions have been included in DRIP to study options for optimizing economic and environmental benefits of a select number of dams as a means to supplement O&M funding – by increasing the revenue generated by dams and reservoirs through tourism, fisheries, and hydro-power generation.
- About 23% of the estimated project cost has been retained as unallocated resources for dam rehabilitation works in some more States. Advance action is being initiated for firming-up the proposals from interested States and other dam owning agencies with a view to tie-up fully the allocation of such resources within a year of project effectiveness.
- DRIP proposal also targets for capacity building of academic and research institutions in the area of dam safety. Advance action has been initiated for the identification of 17 leading institutes and their early involvement in the project – for gaining hands-on experience through consultancies to IAs and for the development of in-house expertise in dam safety.

6. CONCLUSION

With a view of strengthening further the dam safety programmes in India, Govt. of India has taken up for implementation of the Dam Rehabilitation and Improvement Project. Involving initially about 223 dams from four States, DRIP is expected to act as a pilot for achieving the fully operational and safe conditions of Indian dams in a technically and financially sustainable manner, in addition to building needed capacity for monitoring the performance of dams. The proposed project support will be a departure from current practices whereby the main focus is solely on dam operation during flood events, without much consideration of downstream impact. With increasing economic development and population downstream of dams, a more holistic approach to dam safety will be developed with the assistance of the project. New techniques and innovation at par with the international practices would be utilized for the rehabilitation of the dams. Asset management tools and latest guidelines for risk assessment and hazard categorization shall also be prepared. Though involving multiple States and agencies, the project will be considered as a single project entity to be accomplished in project management mode, rather than as separate projects of individual States/ agencies. With the lessons learned from DSARP, a strategic approach is being adopted for its successful initiation and steps have been taken to address all issues upfront.

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NOTE:

The views expressed in this paper may not necessarily belong to the organization which the authors represent.