



GOVERNMENT OF ODISHA,  
DEPARTMENT OF WATER RESOURCES

## DAM SAFETY ACTIVITY REPORT



August, 2018

STATE DAM SAFETY ORGANISATION  
BHUBANESWAR

# PREFACE

Dams have played a very vital role throughout the history of civilization but failure of many dams causing damage to life and property has increased the awareness not only among Engineers, but also among the general public about safety of the dams. As the dams grow older the responsibility of the Engineers increases many fold.

Odisha has 204 numbers of large dams (as per ICOLD classification), which is the 7<sup>th</sup> largest in India in terms of numbers. This includes 10 major project dams, 50 medium project dams and rest 144 dams under minor irrigation projects. The State Dam Safety (SDSO) was established in the year 1981 and has been responsible for monitoring the safety of these dams. Since its inception the SDSO has sincerely taken up this stupendous task of monitoring the health of Dams and is rendering necessary advice to the field units.

Although details about all large dams are well preserved in the State DSO. The Annual Health Status of Large Dams are being published every year with the review of significant deficiency identified during inspections, remedial measures, action taken report, activities of the State Dam Safety Organisation and very pertinent information about each large dam of the State. As new dams are constructed and added to the list of large dams from time to time depending on its upkeep, this report needs to be updated accordingly.

**CHIEF ENGINEER,DAM SAFETY,  
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# **National Dam Safety Programme**

## **VISION**

A future in which the public safety, economic strength, environment and national security of the nation are not threatened by the risk from dam failure.

## **MISSION**

To reduce the risks to life and property from dam failure in the country through the establishment and maintenance of an effective National Dam Safety Programme that brings together the expertise of the resources in achieving dam safety hazard reduction.

## 1. INTRODUCTION

Dams occupy a very pivotal role in the development activities of the civilization. Dams also pose hazard in the event of its failure. The International Commission on Large Dams (ICOLD) has been pioneer in projecting various aspects of dam engineering to ensure proper design and construction of safe dams. During the international conference on large dams at New Delhi in 1979 the dam safety activity in India got an impetus. A Dam Safety Directorate was established in May 1979 in Central Water Commission to assist the State Governments in various activities on dam safety.

The Safety of the Dams in our country is the principal concern of State Agencies those are involved in the various aspects of investigation, planning, design and construction, operation and maintenance. Although most of the dams in the country have performed well, there have been few failures. These failures highlighted the need to review the procedures and the criteria those were adopted by various States with the objective of establishing the best assurance of dam safety within the limitations of present state of art. Consequent to the proposal made during the 5<sup>th</sup> Conference of Irrigation Ministers in November, 1980, the Dam Safety in Odisha was setup in May,1981 with its Headquarters at Burla.

During April 1989, the World Bank proposed to establish a centrally funded scheme for a possible assistance by the Bank as a project to support the institutional strengthening and investments in safety assurance works as identified by an upgraded safety assurance programme.

Accordingly an agreement was signed in 1991 for an assistance of US \$130 Million for Dam Safety Assurance and Rehabilitation Project (DSARP) in Central Water Commission and 4 participating States i.e., Odisha, Rajasthan, Madhya Pradesh and Tamil Nadu. The provision for Odisha was Rs.1273.30 Million (IN-2241)as per the Staff Appraisal Report (SAR).

### **The objective**

- a) To strengthen the institutional frame work for Dam Safety assurance
- b) To upgrade the physical features in and around the selected dams to enhance the safety status as required through basic safety facilities and remedial works.

Later during 1992 the Dam Safety was shifted from Burla to Bhubaneswar and strengthened with additional staff as proposed in the Staff Appraisal Report (SAR) of World Bank. More often the World Bank as well as Central Water Commission (CWC) have emphasized to retain the strengthened structure of the Dam Safety permanently to look after the safety of the large dams in the State as is being done in other dam owning states. Presently the State Dam Safety Organization is a permanent organisation functioning in its own office building inside Secha Sadan Compound.

It is headed by Chief Engineer, Dam Safety supported by adequate technical and non technical core staff.

## **2. PRIMARY FUNCTION OF STATE DAM SAFETY ORGANISATION (SDSO)**

Only large dams as per the ICOLD (International Commission on Large Dams) definition are under the purview of Dam Safety .

### **Definition of Large Dams**

As per ICOLD, a large dam is defined as a dam which satisfies the following criteria.

- (i) a dam above 15m in height from the lowest portion of general foundation to the crest and
- (ii) a dam between 10 & 15m height provided it complies with at least one of the following condition.
  - (a) the length of crest of dam should not be less than 500m,
  - (b) the capacity of reservoir formed by the dam to be not less than 1 Mm<sup>3</sup>.
  - (c) the maximum flood discharge should not be less than 2000 M<sup>3</sup>/sec.
  - (d) the dam has specially difficult foundation problem
  - (e) the dam is of unusual design.

### **Large dams in Odisha**

Odisha has built 204 nos. of large dams of which 60 nos. are Major & Medium Project Dams and 144 nos. of Minor Irrigation Project Dams.

#### **2.1 Inspection of Dams – Phase-I Investigation**

The State Dam Safety Organization has to make Phase-I investigation of all large dams once in 5 years to identify expeditiously the dams which may pose hazard to human life and property. The investigation include an assessment of general condition with respect to safety of the project based on available data and a visual inspection and determines the need for emergency measures and conclude if additional study, investigation and analysis are necessary and warranted.

The work includes:

- a) review of data book
- b) review of available engineering data related to design assumptions and design of structures, construction records, post construction changes, hydrological and hydraulic assumptions and features
- c) review existing record of operation of dam and appurtenant structure including mechanical and electrically operated equipments
- d) review existing maintenance procedure

- e) review of structural behavior based on reading of instruments mounted or embedded in Dam
- f) review periodical inspection reports
- g) conduct detailed field inspection as per prescribed proforma
- h) record at the end of investigation, the assessment of safety of dam, need for additional study, investigation, analysis considered essential to assess the safety of dam, urgency of such additional investigation & advice for Phase-II investigation, if needed.

## **2.2. Phase-II Investigation**

The Phase-II investigation will be supplementary to Phase-I investigation and is conducted when the results of Phase-I investigation indicates the need for additional in-depth study, investigation and analysis.

The work includes

- a) additional visual inspection and surveillance
- b) measurements through instrument mounted or embedded in dams
- c) foundation exploration
- d) material testing
- e) hydraulic and hydrologic analysis &
- f) structural stability analysis.

## **2.3. Pre & Post-monsoon inspection**

Pre-monsoon and Post-monsoon inspection are periodical inspection done every year by the field engineers as per the guidelines prescribed by the Central Water Commission. The reports are received by end of June and November, respectively. Each year these reports of inspections are reviewed at State Dam Safety Organization & the Annual Health status of the dams is published and sent to Government in Department of Water Resources and Central Water Commission for their appraisal.

## **2.4. Hydrological Review of Large Dam**

Hydrological review of all the large dams are essential with respect to the safety of dam as in most cases the design flood has been calculated with the help of some empirical formula based on regional experience. With the advent of new methodology and development of Hydrological Science, the hydrological review of dams has become essential based on hydro-metrological approach following the guidelines fixed by the CWC. The adequacies of existing spillways are reviewed for the enhanced inflow design flood. The method of computation needs specialization of the subject as many assumption, probability, justification are connected with the subject.

## **2.5. Structural Review**

After the hydrological review of a dam, if the spillway is found to be inadequate, alternatives like putting an auxiliary spillway/fuge plug, adding parapet walls, increasing the height of the dam, strengthening or retrofitting the existing spillway are studied and design of such structure are studied in depth.

The structural safety of the dams are also reviewed by analyzing the available instruments data.

## **2.6. Emergency Action Plan (EAP)**

In spite of all precautions and proper maintenance of the dam, some times due to unprecedented natural phenomenon, or due to faulty operation of the reservoir, the dam may face emergency situation such as dam over topping, dam break etc. which may lead to disaster. To cope up with such exigency, Emergency Action Plan (EAP) is to be prepared.

National Council of Dam Safety (NCDS) is always emphasizing the preparation of EAP for all dams of National Importance (Major Dams).

The EAP consists of three phase of work. (i) Dam Break Analysis (2) Preparation of Inundation map (3) Preparation of Emergency Action Plan.

Preparation of Emergency Action Plan involves association of Irrigation Engineers, Civil Authorities and Public administrators.

## **2.7. Inter State Dam Safety Sub-Committee**

In pursuance to the Terms of Reference of NCDS, Inter-State Dam Safety Sub-committees were formed. To monitor the safety aspects of inter-state dams relating to Odisha two Sub-committees were constituted in March 1990 and later reconstituted in 2004 after formation of Chattishgarh and Jharkhand State, One for Mahanadi system and other for Subarnarekha system. The Chief Engineer, Dam Safety, Odisha is the Member-Secretary and Convener for both the Sub-Committees. The other members are the Chief Engineer, Mahanadi Project, Raipur for Mahanadi system and the Chief Engineer, Central Design, Irrigation Department, Jharkhand and the Chief Engineer, Subarnarekha Barrage Project, West Bengal, as the Members for Subarnarekha System. The State Dam Safety Organization is responsible in organizing such meetings.

## **2.8. Dam Safety Review Panel (DSRP)**

A Dam Safety Review Panel has been constituted for Odisha having engineers, geologists, hydrologists with National and International reputation as its members. The main objective of the panel is to provide independent expert review of the reports of distress observed in the investigation, analysis performed and remedial action proposed prior to initiation of rehabilitation activities. The State Dam Safety Organization



organizes the meetings, site visits of Dam Safety Review Panel, gives the feed back to its member and transmits the suggestion of the panel to Government for approval.

The Government of Odisha reconstituted the DSRP-1 with Mr A.D.Mohile as Chairman and Mr Suresh Chandra, Mr R.C.Rath , Mr R.C. Tripathy , Mr P.K. Panda are the other members and DSRP-2 with Mr A.K.Ganju as Chairman and Mr Sudhakar Patri, Mr Nrusingha Charan Mohanty, Mr Padma Lochan Mohapatra are the other members.

## **2.9. State Dam Safety Committee (SDSC)**

To carryout the Dam Safety Assurance Programme, a high level committee comprising senior Administrators & Engineers of Water Resources Department, representative of CWC have been formed. The Secretary of DOWR is the Chairman of the Committee. This committee reviews the progress of the Dam Safety works. The Director, Dam Safety being the Member-Secretary, organizes the committee meeting at regular intervals.

## **2.10. Workshops, Seminars & Trainings**

The State Dam Safety Organization is the nodal agency for conducting workshops, trainings and seminars pertaining to Dam Safety in the State of Odisha.

Various workshops and trainings have been conducted in Bhubaneswar . Engineers of the State have attended National Level Workshops on Dam. Engineers of the State also attended international study tour and training at Deltares in Netherland and USBR at Denver, USA.

## **2.11. Monitoring of rehabilitation work**

The State Dam Safety Organization monitors the rehabilitation works of large dams. Regular progress report, expenditure statements are being sent to Government, Central Water Commission, World Bank at regular intervals.

## **2.12. Dam Safety Assurance & Rehabilitation Project(DSARP)**

The Dam Safety Assurance & Rehabilitation Project under World Bank Assistance was operational in Odisha between June-1991 to September 1997. Under the project fifteen nos of large dams Viz Hirakud, Derjang, Ghodahado, Soroda, Bhanjanagar, Salia, Budhabudhiani, Sarafgarh, Alikuan, Jharanai, Ganianala, Behera, Kumbho, Badjore and Damsal have been provided with basic safety facility like all weather approach road, instrumentation and standby power.

Remedial works of eleven (11) dams namely Hirakud, Derjang, Ghodahado, Bhanjanagar, Soroda, Alikuan, Jharranai, Ganianalla, Behera, Kansbahal and Kuanria were taken up. The major works taken up are : 1.

treatment of cracks and cavities, upgradation of hydraulic gates of Hirakud dam, 2. treatment of crest of dam surface, drainage arrangement and repair of head regulator and radial gates of Derjang dam, 3. resectioning of dam body, providing new spillway with gates of Bhajanagar dam, providing new Sorismuli barrage with gates, 4. rehabilitation of Soroda spillway, raising of dam, drainage arrangement, renovation of Padma anicut with new gates, 5. drainage arrangement and new spillway for Ghodahado dam, 6. protection of spill channel and drainage arrangement in Alikuan dams, 7. spill channel protection and grouting, raising of Behera dam, 8. surface drainage arrangement in Kuanria dam, 9. spill channel protection work in Kansbahal dam and 10. drainage arrangement and spill channel protection works of Jharanai dam.

### **2.13. Dam Rehabilitation And Improvement Project (DRIP)**

#### **Purpose of DRIP:**

Odisha is participating in the World Bank assisted DRIP along with CWC, states of Kerala, Madhya Pradesh, Tamil Nadu and Karnataka. State run Electricity Boards of Tamilnadu and Kerala, DVC and UJVNL also participating in the Project. Initially there was a proposal of rehabilitating 38 large dams based on information received from field authorities, distress conditions identified in the annual health status, 2007 prepared considering Pre & Post-monsoon inspection report, Phase-I investigation report and Expert Panel reports. During the project execution, it is observed that remedial actions have been taken up for 16 large dams either out of state resources or other external funding like World Bank aided schemes like OCTMP and ADB funded scheme like OIIAWMP, hence excluded from the list of DRIP dams. Four other large dams with significant dam safety issues were included under DRIP. Hence at present 26 Dam are under rehabilitation under DRIP. Out of the 26 large dams under rehabilitation, 6 are major project dams, 14 are medium project dams and 6 are minor project dams.

Major Project Dams : Balimela, Hirakud, Rengali, Salandi and Upper Kolab Satiguda (UKP)

Medium Project Dams : Bhaskel, Daha, Dhanei, Derjang, Kalo, Nesa, Pitamahar, Pilasalki, Salia, Sarafgarh, Satiguda (Malkangiri), Sundar, Sapua and Talsara

Minor Project Dams : Ashoknalla, Banksal, Balskumpa, Damsal, Jhumuka and Sanmachhakandana.

#### **Project components:**

##### **A. Rehabilitation & Improvement of Dams and Associated Appurtenance :**

This will focus on structural and non-structural measures for the dams which include 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, flood plain mapping and downstream impact mitigation measures.

## **B. Dam Safety Institutional Strengthening:**

This will focus on legal, regulatory and technical frameworks for dam safety assurance. Among other tasks, the interventions would cover - policy formulation, training and support to Dam Safety Organization (DSO) to assist with the development of appropriate skills and modern design tools, operating cost of expert panels comprising experts in relevant disciplines, dam status inventory and updating on a GIS platform, reservoir conservation techniques, technical training in hazard / vulnerability assessment, dam break analysis, development of emergency action plans, public awareness, attendance at dam safety courses, study tours and linking with other country agencies which have advanced dam safety programs.

## **C. Project Management**

The overall responsibility for project oversight and co-ordination rests with the Central Project Management Unit(CPMU) in CWC headed by a Director. The Directorate is assisted by a management consulting firm "egis". The state has a State Project Management Unit(SPMU) under State Dam Safety Organisation(SDSO) which is responsible for co-ordination and management of the project at state level.. The Chief Engineer ,Dam Safety is the Nodal officer for the project assisted by Director, SPMU. The Technical officers of SDSO are managing the SPMU.

A **National Level Steering Committee(NLSC)** headed by Secretary MoWR and senior level representatives of CWC and participating states is already in place. It gives the policy direction in formulation and implementation of the project and review the physical and financial progress of the project.

A **Technical Committee(TC)** for the project at the Centre has been constituted which is chaired by Member (D & R),CWC and includes Engineer-in-chief/Chief Engineer of Irrigation/Water Resources/Power Department of participating states. The Director DSR-CWC is its member secretary.

The NLSC and TC provide the strategic supervision and direction for the successful implementation of DRIP. These committees provide the platform for resolution of project implementation related issues and also review the progress of the project.

## **PROJECT COST:**

The original project cost was Rs 147.77 Crores which has been revised to Rs 751.19 Crores including the cost of Additional spillway construction for Hirakud dam.

## 2.14 Expert Panels for Safety Review of Dams Once in ten Years :

Large dams those having 15 meter height or with 60 M m<sup>3</sup> storage capacity are to be inspected by independent panel of experts once in 10 years as per the dam safety Guidelines published by Central Water Commission.

Out of 204 large dams of the State, 121 dams come under this category . Three Expert Panel have been constituted during 2003 by Department of Water Resources. Each panel constitutes three members. For each dam separate reports are prepared by the panels after visiting the dam. All the panel members also meet frequently to sort out the problems. List of members in the panel are

Panel 1: Er. Sridhar Behera, Chairman  
Er. Ashok Kumar Das, Member  
Er. Gyanendra Narayan Mishra, Member

Panel 2: Er. Nirmal Chandra Mallick, Chairman  
Er. Rama Krishna Patra, Member  
Er. Saila Bihari Das, Member

Panel 3: Er. Sudhakar Patri, Chairman  
Er. Chakradhara Mahant, Member  
Er. Laxmidhar Mallick, Member

## 2.15 Dam Health And Rehabilitation Monitoring Application (DHARMA)

Dam Health and Rehabilitation Monitoring Application (DHARMA) is a web based asset management software to support the effective collection and management of asset and health data for all large dams in India.

- DHARMA will ensure that details of all stakeholders are **recorded and maintained**. Such details may pertain to individuals as well as organisational entities associated with dam planning and design, construction, operation and maintenance and rehabilitation.
- DHARMA will enable gathering and updating of dam asset information in a **centralised and structured** manner so as to overcome limitations of multiplicity of agencies, wide geographical spread, voluminous data, varied terminologies and units unknown and mismatched time reference and inconsistent formats.
- DHARMA will ensure **prompt capturing** of inspection and investigation data directly by the 'Dam Health Engineers' and provide tools for **correct analysis and interpretation** of this timeline data.
- DHARMA will provide a **complete data collection and management platform** for assimilation of varied information for every dam component across all dam projects, also thereby benefiting from the insights and learning curves of a wider stakeholder spectrum.

The first version of DHARMA was launched at the 14<sup>th</sup> technical committee meeting of the DRIP, held in Kochi, Kerala on May 11<sup>th</sup> 2016. The implementation of DHARMA and capturing data pertaining to the dams covered under DRIP is being initiated. A group named as Dharma Implementation Group (DIG), is also constituted for guiding and supervising the implementation of DHARMA for all DRIP dams. It allows its user to manage the static as well as the dynamic data of the dams under their control. Static data includes the salient and static information for each dam project including name, location, design, purpose, benefits, and component parts of the dams. In dynamic data regular updating of dynamic, time dependent data including current and previous stakeholders, dam health inspection results and associated rehabilitation needs or works can be managed. All information or data are managed in a comprehensive data base, accessible to users with appropriate permission.

Apart from the regular jobs enlisted above the State Dam Safety Organization provides support services to dam operators by way of guiding in preparation of Operation & Maintenance Manual, Rule Curve etc. The SDSO also acts as a data bank for large dams of Odisha.