

Minutes of the twelfth National Committee on Dam Safety meeting held on 10.5.1994 at Central Water Commission, New Delhi.

The twelfth meeting of the National Committee on Dam Safety (NCDS) was held on 10.5.1994 in Sewa Bhavan, R.K.Puram, New Delhi under the Chairmanship of Shri A.B.Joshi, Chairman, CWC and Chairman, NCDS. A list of officers who attended the meeting is given in Annex I.

Shri T.D.Sundarababu, Chief Engineer (DSO) and Member Secretary, NCDS welcomed the Chairman, members of NCDS and officers from the States.

The Chairman, NCDS, opening the deliberations remarked that the progress for the period between the 11th & 12th meeting has not been encouraging. He reiterated that as the recommendations contained in the "Report on Dam Safety Procedures" have formally been accepted by Government of India and NCDS. All the members have to take the responsibility to implement the recommendations. If any difficulty is felt in implementing any of the items of the report, the same must be brought out in the NCDS meetings for discussions. He also observed that the norms of pre- and post-monsoon inspection of dams are not being followed properly. He requested all the members and other officers from the States to accelerate the implementation of recommendations of Dam Safety Procedures and to carry out inspections of the dams as per stipulated norms.

After the above opening remarks, items of the agenda for the meeting were taken up for discussion.

12.1.0 Confirmation of the minutes of the eleventh meeting of NCDS.

- 12.1.1 The minutes of 11th meeting were circulated to all the members of NCDS, special invitees and State Dam Safety Cells vide CWC Letter No.3/19/NCDS/93-DS/1238-68 dated 17.12.93.
- 12.1.2 The member from the State of Karnataka stated that Dam Break Studies for Linganamukhi dam has not been done as stated under para 11.6.2 of the minutes and that only preparation of inundation map and spillway capacity studies for the dam had been completed. No comments were received from any other member States / Organizations. The minutes as recorded were confirmed subject to the amendment as above suggested by the State of Karnataka.

12.2.0 Status of implementation of "Dam Safety Assurance and Rehabilitation Project" for information of the Committee

- 12.2.1 The Chairman informed that DSARP is being implemented in four States, viz. Madhya Pradesh, Orissa, Rajasthan & Tamil Nadu and some more States can also be included as second phase under this project. He, however, mentioned that the physical and financial progress, particularly under the component of remedial action plan by the four States, is not very encouraging. He, therefore, desired that the concerned State may take suitable steps to speed up progress.
- 12.2.2 The Chairman informed the members that the World Bank has already expressed their desire to extend the assistance to some more States which are presently not covered under Dam Safety Assurance & Rehabilitation Project (DSARP), and in this regard CWC has requested the States to submit identification reports, if they desire to avail this opportunity. However, the Chairman categorically stated that the States who desire to participate in the programme must ensure that they have created certain infrastructural facilities to embark on this programme.
- 12.2.3 Institutional strengthening in CWC for the first phase has been completed. Filling up of posts for the first and second phase has been completed in the States of Orissa, Rajasthan and Tamil Nadu while first phase has been completed in the State of Madhya Pradesh. The progress of procurement of vehicle and equipments has been, however, slow.
- 12.2.4 In respect of basic facilities, the participating States have considerably increased their efforts for procurement of meteorological and hydrological instruments, standby power units, etc. However, progress of construction of approach roads in the States except Rajasthan is lagging behind.
- 12.2.5 The progress of implementation of remedial works on dams in all the four States is slow except Periyar dam in Tamil Nadu. However, the States have made considerable progress in achieving the target of Phase I inspection of large dams under their jurisdiction. For carrying out hydrology reviews, Tamil Nadu, Orissa and Rajasthan have already engaged consultancy firms. The process of selection of consultancy firms in the State of Madhya Pradesh is in final stage. CWC, Hydrology Organization, which is responsible for vetting the hydrology of all the 33 identified dams have completed vetting for 4 dams in Madhya Pradesh, 8 dams in Orissa and 2 dams in Rajasthan.

12.3.0 Review of National Scenario.

12.3.1 The States are requested to intimate NCDS, fresh cases of distress in dams, structural and operational deficiencies noticed after pre- or post-monsoon inspections and failure cases, if any, since the last meeting.

12.3.2 No reports on this aspect received since last meeting. The newspaper report on occurrence of cracks in Mandaha dam, Uttar Pradesh and dam safety works in Madhya Pradesh were brought to the notice of concerned State officers during the last meeting, but no report on these incidents were received from the above States. However, the State of Uttar Pradesh submitted the enquiry committee report on the distress of the dams during the meeting. The member from Madhya Pradesh assured to submit the report within two weeks time. Report on problems and remedial measures in Falku Irrigation dams and Raidy dam was received from Gujarat after the meeting, a copy each is enclosed as Annex II & III.

The Chief Engineer and Superintending Engineer (Dam Safety), Maharashtra gave a brief account of the review and remedial measures that are being undertaken for Makani dam (Lower Terna Project). The reservoir water level was restricted from rising. The longitudinal crack developed on right and left earth flank crest has since disappeared. There are no signs of any fresh distress in the dam. The review of design as a result of changed seismic zoning is underway. The strengthening works, if required, will be completed within one year. No fresh distress case has been reported.

12.3.3 Regarding a pending reference on earthquake in Gulbarga District and especially in Amerja Project area in Karnataka that a report has been called from the State, which is still awaited. It was assured that the report would be furnished to CWC within a fortnight.

The Chairman requested all members have to intimate NCDS all such unusual incidents immediately on their occurrence.

12.4.0 Progress of implementation of recommendations of the "Report on Dam Safety Procedures."

12.4.1 The States were requested to implement the recommendations contained in the chapters of "Report on Dam Safety Procedures"

circulated during the year 1987 and send a consolidated report indicating their achievements on various issues and to highlight those recommendations, if any, which were difficult for them to implement.

12.4.2 The States of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and BBMB have submitted their consolidated reports earlier while Andhra Pradesh has submitted after the 12th meeting. Gujarat and Tamil Nadu were yet to submit the latest information. The remaining States Bihar, Kerala, Uttar Pradesh, West Bengal and NHPC were requested to expedite their reports.

12.4.3 Though the key issues, namely, preparation of "Data Books" on large dams, Dam Safety Legislation, review of hydrology on existing dams, preparation of completion reports and Operation & Maintenance Manuals of large dams, etc., were being taken up as separate agenda items. All the States were requested to send a consolidated report highlighting the achievements on the implementation of the recommendations of the "Report on Dam Safety Procedures."

12.5.0 Dam Safety Legislation

12.5.1 All the members, States / Organizations of NCDS were requested to give their concurrence or comments, if any, expeditiously on the draft bill of Dam Safety Legislation. The States of Andhra Pradesh, Gujarat, Kerala, Orissa and Tamil Nadu have sent their concurrence on the Draft. However, Madhya Pradesh, Uttar Pradesh and Karnataka did not consider the legislation essential. The State of Rajasthan has asked two amendments under clause "General" and sub-clause 5(2) and 6(3) in the draft bill of Dam Safety Legislation. The remaining States did not express their views in favour or otherwise on the draft bill. The Chairman suggested that the Dam Safety Legislation is essential as the dams are being controlled by the States / different agencies and the States are free to give their views or suggestions to make necessary changes in the draft bill, if they so desire keeping in view the present trend of privatization of different institutions by the Government. He stressed the need for bringing out such a legislation.

12.6.0 Preparation of Emergency Action Plans and inundation maps for d/s area.

- 12.6.1 A decision for preparation of Emergency Action Plan for downstream areas of dams of National Importance by all the States was taken during the earlier meetings of NCDS. It was also decided that the four participating States – Madhya Pradesh, Orissa, Rajasthan & Tamil Nadu – under the World Bank assisted Dam Safety Assurance and Rehabilitation Project (DSARP) would take up Emergency Action Plans for the 33 identified dams posed for rehabilitation in the first phase.
- 12.6.2 The States of Gujarat and Maharashtra have completed the studies for Machhu-II & Ukai (Gujarat) and Koyna, Paithon & Ujjaini (Maharashtra). Flood zone marking of Linganamukhi dam is completed by Karnataka. West Bengal has initiated studies in respect of Kangsabati and Mayurakshi dams. In case of the dams under (BBMB), the State of Punjab was requested vide CWC letter No.3/19/NCDS/93/DS/263-64 dated 18.2.94 to take up these studies. Information regarding action taken is awaited from Punjab State.
- 12.6.3 The Chairman requested all the States / Organizations to complete this work as early as possible.

12.7.0 Compilation of "Data Books."

- 12.7.1 As per the decision taken in the 4th meeting, "Data Books" for dams of National Importance are to be prepared by the States and sent to DSO, CWC for record.
- 12.7.2 The States of Andhra Pradesh, Bihar, Gujarat, Karnataka and Tamil Nadu and BBMB have submitted "Data Books" for dams of National Importance. NHPC has submitted "Data Book" for Salal HE project. The States of Madhya Pradesh and Maharashtra are yet to intimate further progress in respect of preparation of "Data Books". The State of Rajasthan was again requested to send legible copies of "Data Book" to DSO, CWC.
- 12.7.3 The information from the States of Kerala, Orissa, Uttar Pradesh and West Bengal is still awaited.
- 12.7.4 The member representing the Indian Society of Engineering Geology (ISEG) suggested that instead of giving detailed geological description of the project, data on critical features on geology should be highlighted in the "Data Book" both for existing dams as well as dams under construction. The members from States ISEG requested to circulate available publications on such data pinpointing the critical features.

12.8.0 Preparation of completion report of large dams

- 12.8.1 During the ninth meeting of NCDS, it was agreed that completion reports of all large dams are to be prepared by the respective States giving priority to dams of National Importance. It was decided in the tenth meeting that the original geological report should also form part of the completion report.
- 12.8.2 The States of Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan and Tamil Nadu and BBMB intimated their progress in this regard. The State of Karnataka submitted history of Supa dam and Kaneri dam during the meeting. Most of the States have, so far, given information of dams of National Importance only. It was clarified that completion reports are to be prepared for all the existing large dams.
- 12.8.3 The Chairman requested all the States to pay attention to this work and if the work cannot be completed through their existing set up, this perhaps may have to be got done by engaging consultants, preferably experienced retired officers of the State.

12.9.0 Preparation of Operation & Maintenance Manuals

- 12.9.1 Chairman, NCDS has been emphasizing that Operation & Maintenance Manual is an important document for operation and maintenance of the dams and this Manual should be available before commissioning of the project. As O&M Manuals have not prepared for many dams which are now under operation, the same must be prepared without further delay.
- 12.9.2 The States of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and West Bengal and BBMB have already initiated the work and completed the same for some of the dams. The State of Uttar Pradesh has intimated that each every dam in the State has got O&M Manual except those dams where flank escapes has been provided and height is from 10 to 15 m. The States of Bihar, Kerala, Tamil Nadu and NHPC were requested to take up and complete the Manuals without further delay.
- 12.9.3 The Chairman suggested that the Operation & Maintenance Manual for the smaller dams may also be available. Their operation & maintenance would be easy.

12.10.0 Periodical inspection of dams and the report on dam safety activities in the States.

12.10.1 The States / Organizations are required to perform periodical inspection of dams in their States and send a consolidated yearly report on the status of dams and dam safety activities under the title "Health Status of Dams and Dam Safety Activities in the States" to DSO, CWC.

12.10.2 The States of Gujarat, Karnataka, Madhya Pradesh and Maharashtra & BBMB are submitting yearly consolidated report regularly. The State of Orissa has submitted a consolidated report during the 11th NCDS meeting; NHPC submitted a report for Salal project; Rajasthan is sending periodical inspection reports in piecemeal only; the States of Kerala and West Bengal are submitting periodical inspection report in brief and not a consolidated yearly report indicating status and dam safety activities in the States; and the State of Uttar Pradesh submitted a brief report during the 12th meeting. .

12.10.3 All the States / Organizations were requested to send the yearly consolidated report on health status and dam safety activities to DSO, CWC regularly.

12.11.0 Safety review of large dams once in ten years.

12.11.1 As per recommendations contained in the "Report on Dam Safety Procedures", submitted in 1987 to the Government, safety review of large dams which are more than 15 m in height or which store 60 million cubic metre or more of water, are to be carried out by an independent panel of experts once in ten years. It has also been made clear that the expert committees may be constituted of the officers from the States who were not connected with the construction or maintenance of the structures at any stage.

12.11.2 The States of Maharashtra, Orissa, Rajasthan and BBMB intimated their upto date progress. The State of Maharashtra informed that they propose to undertake a 'Preliminary Review' so as to exclude those dams which are assessed to be safe. For the remaining dams, the possibility of entrusting the work of review of dams to the already constituted Dam Safety Review Panels (DSRP) for MCIP – III would be examined. The State of Orissa have completed review of 82 out of 137 dams. The State of Rajasthan informed that as per programme prepared by the State, the review would be completed by 1997. However,

representatives from Madhya Pradesh informed that their Government feels that it is not necessary to carry out review of dams by an independent panel. The Chairman insisted that the State Irrigation Department should convince the Government for such a review by an independent panel.

- 12.11.3 The States / Organizations that have not yet taken up this work were requested to make a start by identifying dams and complete the work progressively.

12.12.0 Safety status of dams of National Importance.

- 12.12.1 The States were required to prepare safety status of 43 dams of National Importance in the prescribed proforma already circulated. So far, information has been received only for 32 dams.

- 12.12.2 The States of Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal and BBMB have submitted the report for the National Importance dams under their control. Madhya Pradesh has intimated that the report will be submitted shortly. NHPC submitted a report for the Salal dam; the State of Uttar Pradesh has not sent the information in the prescribed format; State of Kerala has not sent any information.

- 12.12.3 The States of Kerala and Uttar Pradesh were requested to send the information to DSO, CWC in the prescribed format immediately.

12.13.0 Monitoring of safety report of inter-State dams by sub-committees.

- 12.13.1 Three sub-committees were set up during March 1990 to monitor the safety aspects of inter-State dams in the Parambikulam Aliyar System (PAP), Mahanadi River System and Subarnarekha System.

- 12.13.2 The State of Tamil Nadu intimated that meetings of sub-committee were held during October 1991 and July 1992 and follow up action is being taken by their field officers on the recommendations made by the committee. The State of Kerala has requested Tamil Nadu to intimate the progress on the follow up actions, to enable them to convene the next meeting.

- 12.13.3 The sub-committee for Subarnarekha River System held two meetings during September and December 1992. However, no information was made available to DSO, CWC on the follow up action taken by the participating States of Bihar and West Bengal. Member from Orissa intimated though the health status of 4 dams in the basin in Orissa has been sent to the States of Bihar and West Bengal, they have not received the status report of 10 dams from West Bengal and 4 dams from Bihar.
- 12.13.4 The State of Orissa convened the first meeting of the sub-committee for Mahanadi River System on 8.9.93 in which officers from Madhya Pradesh also participated. No progress was intimated to DSO, CWC by the participating States of Mahanadi basin. Health status and flood release information of the projects upstream of Hirakud in Madhya Pradesh sought by Orissa has not yet been furnished so far.
- 12.13.5 All the participating States were requested to convene meetings of sub-committees regularly and inform DSO, CWC the safety status of inter-State dams and the follow up actions taken on the recommendations of the committees.
- 12.14.0 Setting up of hydrological unit in the States for review of hydrology of existing dams.**
- 12.14.1 Hydrology of existing dams is required to be reviewed by setting up or strengthening existing hydrology units in the States. Some States / Organizations have already initiated actions for strengthening / setting up of hydrology units and taken up review of hydrology of some of the dams.
- 12.14.2 Gujarat, Madhya Pradesh, Maharashtra and Orissa have completed hydrology review of 452, 30, 35 and 26 dams in their States respectively; BBMB also submitted their report for the dams under their control; Orissa informed that two nos. of hydrology review divisions are functioning under DSO. Maharashtra, Tamil Nadu and Uttar Pradesh informed that strengthening of existing hydrology unit has yet to be taken up. However, the review work of some of the dams is in progress. Rajasthan intimated that the existing hydrology unit would do the review of 124 dams in the State. Bihar and Karnataka informed that the review is being done by separate units in their States; Andhra Pradesh and West Bengal are awaiting strengthening of their DSO units for taking up this work. No information was received from Kerala and NHPC.

- 12.14.3 All the States / Organizations were requested to take up hydrological review and complete expeditiously.

12.15.0 Instrumentation for dams.

- 12.15.1 In the 6th meeting, it was decided to take stock of the status of instrumentation installed on all large dams in order to see their performance, mortality, periodicity for analysis of data, referring the analysis to the designers for their suggestions, studies of structural behaviour report and the adequacy or otherwise of the staff engaged on the job. Information reported by some of the States / Organizations are as under:

| | |
|----------------|---------|
| Andhra Pradesh | 3 dams |
| Gujarat | 25 dams |
| Karnataka | 2 dams |
| Kerala | 7 dams |
| Madhya Pradesh | 11 dams |
| Maharashtra | 46 dams |
| Orissa | 14 dams |
| Tamil Nadu | 6 dams |
| BBMB | 3 dams |

Tamil Nadu informed that micro-earthquake instruments would be installed on Mettur and Vaigai dams. In the State of Uttar Pradesh, micro-earthquake instruments have been installed on Ramganga dam.

- 12.15.2 All the remaining States / Organizations were requested to expedite submission of information to DSO, CWC. The Chairman stressed the need for analysis of data also.

12.16.0 Standardized meteorological and other observations.

- 12.16.1 All the States were requested to supply detailed information in a specified format on the type of meteorological instruments installed in the catchment areas and reservoirs of large dams for meteorological observations. The States of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh and BBMB had supplied information in respect of some dams. The State of Orissa

informed that 15 dams covered under DSARP were selected for providing meteorological observation units at dam sites and installation of instruments was in progress. The State of Rajasthan was also requested to intimate information regarding type of instruments installed.

12.17.0 Data on gated storages.

- 12.17.1 The States / Organizations have been requested to furnish data on gated storages of large dams in a specified format. The data received from Orissa and Rajasthan is incomplete. The State of Orissa has supplied information for 28 out of 48 dams and Rajasthan for 22 out of 28 dams. The State of Bihar and NHPC have not sent any information. The above States / Organizations were requested to expedite information.

12.18.0 Safety inspection of barrages.

- 12.18.1 During the 7th NCDS meeting, it has been decided to collect State-wise information in respect of all barrages in a prescribed format and send to DSO, CWC. The information has been received from most of the States except Bihar and Uttar Pradesh. The State of Uttar Pradesh has furnished information in respect of 14 out of 25 barrages and Bihar has not responded so far. NHPC also was requested to supply data of barrage under them.

12.19.0 National Register of Large Dams

- 12.19.1 A publication titled "National Register of Large Dams" (NRLD) brought out by DSO, CWC was circulated to all the representatives from various States / Organizations for scrutiny and corrections / modifications / additions, if any.
- 12.19.2 Information from Orissa and Rajasthan is awaited. The State of Uttar Pradesh has informed that there are total 145 large dams in the State and the details were given during the meeting. As the revised publication is to be brought out shortly, the States were requested to expedite the information. It was also brought to the notice of all member States / Organizations that the entire data for the "National Register of Large Dams" has been stored in NIC Computer and the same can be retrieved by the States / Organizations on NICNET System even at the District level throughout the country.

12.20.0 Seismic status of dams of National Importance.

- 12.20.1 DSO, CWC has forwarded a document titled "Guidelines for Inspection of Dams following Earthquake" to all the members of NCDS with a request to make use of this format and report to NCDS immediately after occurrence of each earthquake.
- 12.20.2 After the occurrence of Uttarkashi earthquake in October 1991, reports were received only from BBMB in respect of 3 dams; NHPC for Salal dam and Uttar Pradesh for Ram Ganga dam. All the northern States were expected to conduct a thorough inspection of large dams in their States in accordance with ICOLD Guidelines and report the findings to NCDS.
- 12.20.3 After the occurrence of recent earthquake in the early morning of 30.9.93 in Latur and Osmanabad Districts of Maharashtra, the States of Andhra Pradesh, Karnataka and Maharashtra were also requested to assess the conditions of water resources structures in their regions and conduct post-earthquake survey in accordance with the "Guidelines for Inspection of Dams following Earthquake" brought out by the International Commission on Large Dams (ICOLD) and report the findings to the Committee. The State of Andhra Pradesh and Maharashtra have submitted their reports. The Experts Committee constituted by the Government of India under the Chairmanship of Chief Engineer (DSO) and other members from the IMD, GSI, Government of Maharashtra and CWC has also submitted their report to the Government.
- 12.20.4 The Director General, GSI has informed that they do not possess expertise to recommend instrumentation system required for monitoring the structural response of the dams. Copies of list of instruments and accessories required for monitoring micro seismic activity in dam sites received from the Director General, GSI has been sent to all members of NCDS and Dam Safety Cells in the States.

12.21.0 Problem bank on research & development.

- 12.21.1 All the members of NCDS were requested to suggest areas requiring research for development of projects and gadgets in the field of dam safety and send their suggestions to DSO, CWC. The Chairman, during the 10th meeting, desired that the States should examine the list circulated as Annex II of the special areas suggested for "Conducting Research on Dam Safety" and take up research on a subject of their choice. They should also

prepare a project report on the scheme for research and send the same to Member (D&R).

No suggestion has, so far, been received from any of the States / Organizations. All the States / Organizations were again requested to consider this item actively and to come forward specifying the areas required for research and development of projects and dam safety. All the States promised to look into this matter and send their proposals.

12.22.0 Any other item with the permission of Chair

- 12.22.1 Under this item, the State of Karnataka requested to discuss in general the question of seepage in dams and the quantum that can be considered as normal and the remedial measures that should be taken to check such seepage. The Chairman indicated that the seepage coming from the dams has to be properly measured and analyzed. Seepage water must be tested for its chemical contents. Further, the type and quantity of solids being carried by it should be properly analyzed before any measure is taken to check the seepage.

The meeting ended with a vote of thanks to the Chair.

12.3.0 Review of National Scenario

12.3.1 General

Falku Irrigation dam is in taluka Dhangdhra of Surendranagar District. Spillway is constructed in river portion while homogeneous earth dam is constructed on both the flanks. The H.R. is on left bank at ch.480 m.

12.3.2 Problem

Due to heavy rain in the catchment area of this scheme on 16.7.93 and 17.7.93, the downstream H.R. of Falku earth dam at ch.480 m near H.R. leakage was observed and due to this the earth dam of upstream slope near H.R. was settled and earth dam near H.R. was damaged.

12.3.3 Probable reason

The damages to earth dam near H.R. is due to improper bondage between top of concrete above conduit and earth work. This might have resulted leakage of water and ultimately damaged the earth dam.

12.3.4 Site inspection

On instruction of Government, Superintending Engineer, Central Design Organisation, Superintending Engineer (Geology), CDO, Joint Director, DSO, GERI, Vadodara and Joint Director (Irri) inspected the site on 20.7.93. the joint team have studied the causes of damages and suggested the immediate and permanent remedial measures for repairs of the damaged portion. The joint report was studied under Chief Engineer (QC) and Joint Secretary with all visiting officers was submitted to Government. After complete discussion, following remedial measures are suggested.

12.3.5 Repairs to upstream slope of earth dam near H.R.

- 12.3.5.1 The damaged earth work on upstream of earth dam near H.R. may be removed as per requirement. On this surface earthwork of impervious soil in 2.5 m width be laid upto ground level. A layer of 1.0 m depth and 9.5 m in width may be filled near upstream toe. On this a layer of 2.0 m width semi-pervious type soil may be filled upto G.L. Over this filter and pitching work may be carried out as per design section. All the restoration work should be carried out upto R.L.107.30 m under strict quality control and as per the dam cross section. Such new work

may be carried out upto 7.5 m on both side from the centre line of H.R. During execution of work care should be taken so that H.R. well should not get damaged.

12.3.5.2 To get the complete water tight condition, the H.R. conduit pipe laid in pit may be filled with concrete upto ground level and upto 6.0 m on downstream of H.R. well. However, for good bond between old and new concrete, the old concrete surface may be raised. Simultaneously, to satisfy the creep line concrete fin may be provided at 3.0 m from H.R. well upto 2.0 m in length. It should be ascertained that H.R. conduit pipe and H.R. external as well as internal joints are water tight.

12.3.5.3 On upstream toe of earth dam 0.5 m width and from stone surface 0.3 m depth pit may be excavated and filled with impervious soil. This pit should be concreted with new layers of impervious soil provided in earth dam and this pit may be extended upto 1.0 m in length beyond the old earthwork pit. This pit may be excavated only by manual labour and not by blasting.

12.3.6 **Repairs to downstream slope of earth dam**

12.3.6.1 The damaged portion on downstream slope of earth dam, both side from H.R. be excavated upto 5.0 m and on this surface 0.6 m thick chimney type sand filter may be provided and connected with horizontal filter. Thereafter on this surface, available semi-pervious soil may be laid as per design section. The rock toe may be opened upto 5.0 m in length including damaged portion of H.R. checked and be redone as per design section. While carrying out the work, steps provided on downstream slope may be removed upto certain height and constructed thereafter. Over and above, the portion, where berm is not provided and rain water flows on slopes towards rock toe, may be opened up, checked and redone.

12.3.6.2 The repairs to earthwork on upstream and downstream slope may be carried out one after the other.

12.3.7 **Present position**

The immediate repairing work of Falku dam has been completed after constructing ringbund around H.R. The remaining work is in progress.

**A report on seepage observed in the
masonry dam of Raidy Irrigation Scheme**

General

Raidy dam is constructed on Raidy river of Rajula taluka of Amreli District. The FRL of reservoir is 50.85 m and was first filled in the year 1986.

Field visit

It was reported by field officers that there is leakage in the masonry dam. The visit to the scheme was arranged in order to know the extent of seepage through the dam and to suggest suitable measures to control it. The officers of CEO and DSO visited the site on 20.11.93. On the day of visit, the reservoir water level was at about RL 48.70 m.

Masonry dam

(a) Right downstream training wall:

- (i) Heavy seepage was observed through 7 weep holes provided in the wall. The wetness was also noticed on river side face of this masonry wall.
- (ii) A crack is noticed in the right downstream training wall at about 11.0 m downstream from dam axis. This crack is observed from RL 51.0 m from top of wall down to about RL 48.0 m, upto the pier. The crack was first reported in 1989. The width of this crack is about 5 mm at top. It was noticed that this crack also extends towards the earth fill side.

(b) Left downstream training wall:

Only one weep hole at RL 34.50 m in this wall was seen functioning. Heavy seepage was noticed through this weep hole. The wetness was also noticed on river side face of this wall in bucket region. Other weep holes provided in the wall are not functioning.

Spillway

- (i) It has been noticed that heavy leakage in downstream of block No.7 is taking place.

- (ii) Leakage of water from few locations on downstream glaces of spillway block No.6 to 9 noticed. Some leakage was also noticed through lift joints of the pier.
- (iii) Some portion of pier cap concrete of left end pier (gate No.9) is seen crushed in about 1 m depth from top.

Tail channel

The width of the tail channel is inadequate as there are high rock outcrops beyond end still of bucket.

Remedial measures

- (1) Seepage from the right side downstream training wall seems to be perhaps, through the masonry of the wall and key. In order to prevent the entry of water from upstream through the key, grouting without pressure may be carried out in consultation with CDO and GERI.
- (2) The crack observed on the right side downstream draining wall between RL 51.0 m to 48.0 m should be filled by epoxy / M-seal after cutting V-groove along the crack and after suitably filling the gap with rich cement mortar / slurry. While treating the crack on top of wall, reinforcement bars of 16 mm ϕ should be provided about 200 mm c/c and concrete layer of 15 cm should be laid on it.
- (3) The bucket should be dewatered and inspected for damages, if any. The damages should be repaired by epoxy treatment / concrete.
- (4) The outfall pipes provided in body of the spillway may be reactivated suitably if found choked.
- (5) The damaged concrete of crushed portion of left side end of pier No.9 to may be rectified suitably with concrete of appropriate strength.

Present position

The repair works of damaged downstream right side training walls are completed and the work of estimates for remedial measures and monitoring is in progress.