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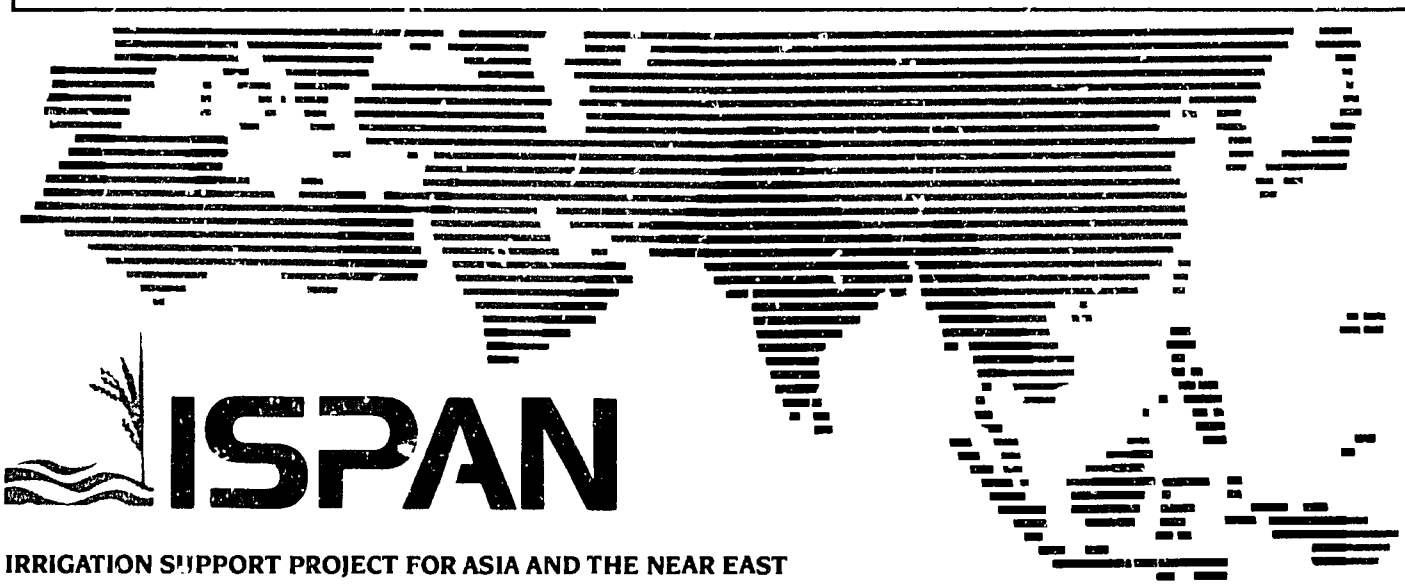
Madhya Pradesh Minor Irrigation Project
Bureau of Design for Hydroelectric and
Irrigation Projects (BODHI)

ORGANIZATION REPORT

ISPAN Activity No. 622A

ISPAN Report No. 31



IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST

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ISPAN Report No. 31

Madhya Pradesh Minor Irrigation Project
Bureau of Design for Hydroelectric and
Irrigation Projects (BODHI)

ORGANIZATION REVIEW

Prepared for the USAID Mission to India,
under ISPAN Activity No. 622A

by

Pritam Singh
and
H. Walter Anderson

February 1989

Irrigation Support Project for Asia and the Near East
Contract No. ANE-0289-C-00-7044-0, Project No. 3-7631510
is sponsored by the Asia/Near East Bureau
U.S. Agency for International Development
Washington, D.C. 20523

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ACRONYMS

BODHI	Bureau of Design for Hydroelectric and Irrigation Projects
CADD	Computer-aided Design/Drafting Systems
CWC	Central Water Commission
DRP	Dam Review Panel
GOMP	Government of Madhya Pradesh
ISPAN	Irrigation Support Project for Asia and the Near East
NVDA	Narmada Valley Development Authority
USAID	U.S. Agency for International Development
UNDP	United Nations Development Program

CURRENCY EQUIVALENCIES

U.S. $1 = Rs. 16.84

Rs. 1 crore = Rs. 100

Rs. 1 lakh = Rs. 100,000

ACKNOWLEDGEMENTS

A number of individuals and organizations helped to make this review possible. Thapar Hydroconsult provided the services of Pritam Singh. W.A. Garvey of the Irrigation Support Project for Asia and the Near East (ISPAN) made arrangements for the participation of H. Walter Anderson.

In Delhi, Glen Anders, Chief of the Office of Irrigation and Water Resources, USAID mission, J.R. Khanna, Project Officer, and the staff of the USAID mission gave excellent support to the review process.

In Bhopal, H.N. Gandhi, head of Thapar Hydroconsult's Liaison & Coordination Unit for USAID, assisted in the Madhya Pradesh Minor Irrigation Project, and his staff provided the support for conducting the review. O.N. Thapar, Chief Engineer, BODHI, generously responded to our numerous requests for information and set up the meetings with senior officers of the Madhya Pradesh Irrigation Department.

V.K. Jadwani and Ambaji Rao, superintending engineers, were our hosts on tours of the Kaliasote and Kolar Projects.

EXECUTIVE SUMMARY

Pritam Singh and H. Walter Anderson were retained by the U.S. Agency for International Development (USAID) to review the organization of the Bureau of Design for Hydroelectric and Irrigation Projects (BODHI) of the Government of Madhya Pradesh Irrigation Department in India. They interviewed the officers of BODHI, reviewed their facilities, and visited irrigation projects under construction. They also held discussions with senior officers of the Madhya Pradesh Irrigation Department.

The Irrigation Department will have an extensive design and construction program over the foreseeable future. There are no major changes required in the basic organization of BODHI. However, BODHI needs to become more involved in the planning, construction, and water-utilization activities of the department. A procedure for performing independent technical reviews also needs to be established.

BODHI's efforts for expanding its computer facilities and library are sound and should be continued. Training efforts should continue. BODHI needs to improve its laboratory by expanding the equipment and obtaining modern data-acquisition systems. The office equipment should be modernized.

The greatest need for additional review at this time is in geotechnical sampling, testing, and evaluation.

Chapter 1

INTRODUCTION

The Bureau of Design for Hydroelectric and Irrigation Projects (BODHI) was established by the Government of Madhya Pradesh, India, in 1985 to prepare designs and specifications for dams, canals, and appurtenant works required for major and medium irrigation projects. A major irrigation project is defined as one that irrigates more than 10,000 hectares (25,000 acres). A medium project irrigates 2,000 to 10,000 hectares (5,000 to 25,000 acres).

Madhya Pradesh is a landlocked state in central India. It is the largest state in the country with much potential for water resource development. The work that is now starting on the Narmada River is one of the largest on-going water resource projects being developed in the world.

Pritam Singh, former Chairman of the Central Water Commission (CWC) of India, and H. Walter Anderson, with Harza Engineering Company, USA, were retained by the U.S. Agency for International Development to review the organization of BODHI and comment upon methods of expanding and/or strengthening BODHI. The scope of work for the review is contained in Appendix A.

Mr. Singh and Mr. Anderson were in Bhopal, the capital of Madhya Pradesh, from late January, 1989, through February 4, 1989. Mr. Singh arrived on January 24, Mr. Anderson on January 26. They interviewed the officers of BODHI, reviewed their facilities, and visited irrigation projects under construction. Discussions were also held with other officers of the Irrigation Department. A list of the officials met in Madhya Pradesh is contained in Appendix B.

The draft report prepared by the team was presented to the Chief Engineer, BODHI, on February 2, 1989. Thereafter, discussions with the Chief Engineer were held and the report was completed.

Chapter 2

MADHYA PRADESH IRRIGATION DEPARTMENT

The bulk of the irrigation work in Madhya Pradesh is under the authority of the Department of Irrigation of the Government of Madhya Pradesh (GOMP), except for the large projects on the Narmada River for which the Narmada Valley Development Authority (NVDA) has been established. The responsibility for irrigation at the farm level for some major projects is with the Command Area Development or Ayacut Department.

2.1 Organizational Structure

The head of the Department of Irrigation is the Engineer-in-Chief. Reporting to him are 16 chief engineers who supervise various projects, zones, and activities. The following four chief engineers have statewide responsibilities:

1) Bureau of Design for Hydroelectric & Irrigation Projects
2) Survey & Investigation
3) Tubewell and Lift Irrigation
4) Electrical & Mechanical

There are seven zonal or basin chief engineers who are located in various parts of Madhya Pradesh. These chief engineers have responsibility for investigations, planning and design, supervision of construction, and operation and maintenance of medium and minor irrigation projects. In addition, construction and O&M of a few major projects are supervised by some of the chief engineers.

In the past, designs for dams for certain medium and all major projects were prepared by the Central Water Commission. It is expected that in the future BODHI will perform the design function presently performed by CWC. The design work for major structures of the NVDA has also been entrusted to CWC. The detailed technical examination of major projects and summary examination of medium projects, prior to their inclusion in the five-year plans, will remain with CWC.

2.2 Staffing and Budget

The Engineer-in-Chief has supervisory responsibilities for approximately 29,792 individuals, 13,653 of whom are engineers. The cadre management of engineering personnel under the NVDA is also performed by the Engineer-in-Chief.

The total outlay of the Madhya Pradesh Irrigation Department in the Seventh Plan is Rs 17,220 million. The Eighth Five-Year Plan is still under formulation. However, from past experience, it is expected that the outlay for a subsequent five-year plan in the irrigation sector will be double that for the preceding five-year plan.

The civil works of the hydroelectric power projects in close proximity to the dams or irrigation canal structures are generally constructed by the Irrigation Department, although the over-all responsibility for power development lies with the Madhya Pradesh Electricity Board (a public sector undertaking).

2.3 Water Utilization

The responsibility for water utilization in major projects is with the Ayacut Department which is under another ministry. The work involved in the improvement of irrigation practices at the farm level in 50 minor irrigation projects under the USAID-Madhya Pradesh Minor Irrigation Scheme is monitored by the Engineer-in-Chief, with the assistance of two Superintending Engineers who head the Special Appraisal and Supervision Cell and Special Coordination Cell respectively. BODHI is not entrusted with any role connected with water utilization, nor is such a role envisaged in the near future by the senior officers of the Irrigation Department.

Chapter 3

BODHI ORGANIZATION

3.1 Responsibilities

The Chief Engineer of BODHI is responsible for preparing designs and drawings for:

1) Major Projects

   (a) Dams
   (b) Spillways
   (c) Appurtenant Works

2) Medium Projects

   (a) Earth dams above 27 meters in height
   (b) Masonry or concrete spillways with flood lift more than 3 meters, or fall more than 8 meters

3) Canals

   (a) Typical designs for canal structures of 6 cumecs (210 cfs) and above
   (b) Canal structures with pile and well foundations
   (c) Canals with discharge greater than 30 cumecs (1,000 cfs)

      - Drainage syphons, culverts and aqueducts greater than 15 meters in waterway
      - Canal falls more than 2 meters
      - Cross regulators, cross-communication works and escapes

4) Tunnels

5) Power stations up to 25 MW

In addition, BODHI updates and circulates technical circulars and specifications throughout the department, and examines project reports for medium and major irrigation projects. BODHI also processes cases of revised administrative approval of all major and medium projects referred by GOMP.

3.2 Organizational Structure

The BODHI organization is headed by a Chief Engineer who reports to the Engineer-in-Chief of the Irrigation Department. BODHI is divided into the following eight directorates:

1) Canals
2) Dams
3) Dam Safety
4) Gates & Valves
5) Hydrology
6) Irrigation Research
7) Rates & Costs
8) Specifications

In addition to the eight Directorates, the following three cells also report to the Chief Engineer, BODHI:

1) Administration
2) Computer
3) Drawing

There are approximately 90 engineers in BODHI. Total strength at the present time is 209. There are 132 vacancies from the approved number in the organization, mainly in the technician and clerical positions.

The Government of Madhya Pradesh has granted various incentives to personnel engaged in design and research work in order to attract and retain competent workers. Continuity of personnel and a sufficient workload will foster the specialization necessary to achieve technical excellence in a design organization like BODHI.

3.3 Future Workload

In the next five-year plan, there will be five new major projects, in addition to on-going major projects requiring BODHI involvement. In addition, medium projects totaling Rs. 12,000 million that meet the criteria listed above will also come under the purview of BODHI. With this anticipated workload, the staff at BODHI is likely to expand.

Chapter 4

BODHI STRENGTHS

4.1 Organizational Structure

The organizational structure is appropriate for the current mission of BODHI. Areas of responsibility are clearly defined; there is no question about who is in charge. The organization of BODHI has been and can be expanded in the future to cope with increasing workload.

4.2 Engineering Methods

Methods of analyses similar to those found in offices in the United States were observed in the work projects examined in the review. The main difference was in the extent of computer analyses and the lack of word processors and computer-aided design/drafting systems (CADD). The construction work is a little different from that encountered in the United States because most of the structures are constructed of masonry rather than concrete. A large part of all the work is done manually rather than by machines.

4.3 Documentation

Work observed during the review was well documented. It was easy to follow the assumptions made for an analysis, the design criteria, the calculation, and the results.

4.4 Technical Review

Documents seen during the review had all been reviewed by one or more individuals other than the originator. The reviewers noted their responsibility by writing a clear statement of acceptance and signing their names. In the case of World Bank-funded projects, a Dam Review Panel (DRP) of senior technical experts also had reviewed the work relating to dam safety.

4.5 Computer Use

BODHI has one Apple Mackintosh personal computer. The library of available programs is impressive. They range from the standard spread-sheet, word processor, data-base programs to a wide range of engineering programs. A detailed list of the programs is given in Appendix G, Annexure 3. These programs were observed in the work projects observed.

BODHI is going to acquire four IBM AT machines, along with the appropriate printers and software. They are also obtaining the latest version of AutoCAD and a plotter. When installed, their computer resources will be significantly increased. As this technology is integrated into everyday work, the four computers will not be sufficient for an organization of BODHI's mission and size. However, BODHI can incrementally add computers as the workload demands. When this occurs, they will be as well equipped as a mid-size engineering firm in the United States.

4.6 Laboratory

BODHI has a well-equipped laboratory located at Hathaikheda, about 14 km from their main office. They have the following labs:

1) Chemistry
2) Concrete & Mortar
3) Hydraulics
4) Soils

The laboratories are clean and modern, and the engineering staff was well versed in lab methods. The main difference between BODHI labs and those found in similar organizations in the United States is the lack of computerized data-acquisition systems for the testing devices.

In addition to the lab at Bhopal, soils and material testing labs have been established at Raipur and Jabalpur.

BODHI is in the process of upgrading its labs. Lists of equipment on hand, being procured, and desired are given in Appendix C. Expanding the geotechnical capabilities of the lab has the highest priority. Developing a photo-elastic lab is questionable in light of the finite-element method of analysis, which will be within BODHI's capability with the new computers.

4.7 Library

BODHI has a reasonably equipped technical library. Recent additions of Indian and American technical journals are readily available. They are in the process of updating the library materials. The list of additional books to be obtained is well thought-out. When these new documents and periodicals are obtained, BODHI staff members will have better access to technical material than frequently is found in an American design office.

4.8 Training

The officers of BODHI are being sent for training on the basis of proposals for refresher courses, etc., received from various organizations. A list of courses and workshops normally attended by the officers of BODHI is contained in Appendix E. One director and eight deputy directors have gone abroad under USAID/UNDP workshop and training programs. Two assistant directors are presently being trained in the Central Water and Power Research Station, Pune.

The proposal for training of officers of BODHI in India and the United States by the U.S. Bureau of Reclamation is under active consideration.

Chapter 5

BODHI WEAKNESSES

5.1 Organizational Structure

The Chief Engineer of BODHI has to supervise eight directors and three Cells. This is a very broad span of responsibility. Although the Chief Engineer is "on top of his program" and knows what is going on in all Directorates, consideration should be given to adding an Assistant or Associate Chief Engineer to the organization.

5.2 Independent Technical Review

Although a Dam Safety Panel of senior technical experts is used when a project is funded by the World Bank, it is not clear as to how a non-World Bank project would be reviewed by an independent body. All project reports are technically examined by CWC, but there is no review by CWC or any other independent body of detailed design or construction procedures.

It is vital that projects BODHI is associated with are reviewed by individuals who are not intimately involved in their preparation.

Independent review can be obtained by any of the following methods:

1) Board of experts from outside BODHI
2) Special Cell within BODHI to provide review
3) Form ad hoc review groups from within BODHI using individuals who have not been involved in the work.

Pritam Singh favors the setting up of a Directorate (Checking) for concurrent review of the designs prepared by the producing Directorates.

5.3 Management Information

Since BODHI does not need to keep track of costs for each project that is in the works, there is a lack of management information that would normally be found in an American engineering organization. They have not yet begun to use the computer to track the status of design work.

5.4 Involvement in Planning

At the present time, BODHI is not routinely involved in the planning work being done by the Department of Irrigation. BODHI does receive requests from the planners for help on special projects. Many organizations throughout the world have found that it is imperative to have those who will prepare the final designs for a dam involved in the initial planning for the project. Many major decisions involving dam type and general layout are made during the planning process. Once a plan is approved, there is usually a "momentum to build" that prevents the final designers from developing alternatives to the approved plan. Designers who are involved in the planning are usually more knowledgeable about the project and more enthusiastic about their work.

The hydrology and designs in some of the Department's planning reports could probably be improved if they are reviewed by BODHI. At present, there is limited involvement by BODHI in hydrological observations, ground water, hydropower, and water utilization.

5.5 Involvement in Construction

At the present time, BODHI has limited involvement in construction. As discussed above regarding involvement during planning, it is even more vital that the designers become routinely involved during the construction of medium and major irrigation projects. Increasing designer involvement during construction will have the following benefits:

1) Minimize misinterpretation of the designs

2) Recognize when conditions occur that were not anticipated during the design

3) "Educate" the designers on some of the construction problems that their designs create

4) Develop a team spirit among designers and field engineers

5) Encourage designers who see the fruits of their labors to be more enthusiastic about their work.

5.6 Lab Involvement in Field Work

BODHI's lab has limited involvement in field investigations, sampling, field testing, and quality control. In comparable dam design organizations, the central lab would have more involvement in overseeing the technical work of the field labs.

5.7 Laboratory Equipment

Although well equipped, BODHI's labs do not have computerized data-acquisition systems. The labs need to be reviewed by individuals familiar with data-acquisition systems, and the costs and benefits of a modernization program need to be developed. A list of lab equipment being procured and needed are given in Appendix C.

5.8 Office Equipment

Modern office equipment is woefully lacking in BODHI. They do not have a xerox machine, and the only word processing is that provided by the Apple Mackintosh. The use of spread sheet and data-base programs for listing and updating equipment lists and status of on-going work is non-existent. A list of office equipment desired by BODHI is given in Appendix D.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The Government of Madhya Pradesh Irrigation Department will have an extensive design and construction program for the foreseeable future.

Major changes in the basic organizational arrangements in BODHI are not required.

BODHI needs to be more involved in the planning, construction, and water utilization activities of the department.

A procedure for performing independent technical reviews of the major designs needs to be established by BODHI.

Additional lab equipment is needed so that BODHI can fulfill its obligations.

Modern office equipment is needed so that BODHI can function in a more expeditious manner.

The greatest need for additional review at this time is in the area of geotechnical sampling, testing, and evaluation. A review of hydrology by those familiar with areas of limited hydrologic data is next in priority. A review of hydraulic lab procedures by those familiar with computerized data-acquisition systems would also be desirable. A review of planning and construction practices is not needed at this time.

6.2 Recommendations

Procedures need to be developed to routinely involve BODHI in the planning activities, including hydrologic planning, for those projects that are likely to be designed by BODHI. BODHI should be involved in investigating potential dam sites, in the alternative layouts of the dams and appurtenant works, and associated geotechnical investigations.

Procedures need to be developed to routinely involve BODHI in the construction activities for those projects that are designed by BODHI. The designers should visit dam projects periodically throughout the construction period, with special visits at critical stages of construction.

If measuring instruments are provided in some structures of a project, analysis of the instrumentation data should be carried out by the design Directorate concerned.

Procedures need to be established to ensure that independent technical reviews are routinely made for all major designs.

Consideration should be given to adding an Assistant or Associate Chief Engineer to the organization.

BODHI engineers should be aware of improved technology and management in water utilization and the implications affecting design of irrigation systems in major and medium projects.

The Department of Irrigation should strive to have a continuity of personnel and a sufficient workload at BODHI to foster the specialization essential for achieving technical excellence.

BODHI's training efforts should continue. It is important that BODHI's personnel have periodic exposure to the latest design practices and developments abroad. Before training or attendance at seminars in foreign countries, persons concerned should bring themselves up-to-date in the best practices within India by visiting organizations in India doing similar work.

It would be useful if the Chief Engineer, BODHI, accompanied by one or two other senior engineers, would visit important design and research organizations in India. BODHI engineers should also be involved in the design work performed by NVDA by secondment or attachment to the concerned design organizations.

USAID should develop a format for BODHI to list its equipment needs and indicate its priorities in one place. A standard spread sheet program such as Lotus 1-2-3 could be used. The list should contain enough information so that the decision maker could evaluate the request.

Lists of lab and office equipment desired by BODHI are contained in Appendices C and D. With the exception of the photo-elastic equipment, the requests are reasonable and the equipment should be purchased, depending on their priority within the funds available. Geotechnical equipment is of highest priority. Obtaining a xerox machine and modern typewriters has the highest priority among the requests for office equipment. Establishing a photo-elastic lab should be individually justified since the modern trend is to solve these types of problems with a computer.

BODHI should use its computer to maintain a status report of its activities. In addition to status, the report could also indicate responsibilities and estimated completion dates.

The following teams, in order of priority, consisting of one Indian specialist and one American specialist, should be formed as the next step in strengthening BODHI:

1) Geotechnical
2) Hydrology
3) Hydraulic models

Specific requirements for these teams are given in Appendix F.

APPENDIX A -- SCOPE OF WORK FOR ORGANIZATIONAL REVIEW

The following scope of work for the review was given to the review team by the USAID Mission in Delhi:

Subject: EXPANSION/STRENGTHENING OF BODHI - GOMP, SCOPE OF WORK FOR PRELIMINARY MISSION: Jan 23 - Feb 6, 1989

1. Determine the present and future role of BODHI in the light of the work load anticipated for the next few five year plans for the development of the water resource of GOMP including water utilization and hydro electric projects.

2. Carry out detailed discussions with GOMP senior officers and other specialists to determine organization requirements ie staffing training, needs for project planning, investigation and design activities.

3. Analyze organizational and institutional strengthening alternatives and options.

4. Define scope of work and qualifications of specialists for next mission for strengthening of BODHI.

5. Prepare and discuss the draft report with GOMP officers and finalize the report.

6. Debriefing session at USAID

APPENDIX B -- OFFICIALS MET IN MADHYA PRADESH

Irrigation Department

Mr. J.R. Malhotra, Secretary

Mr. K.N. Venkataraman, Additional Secretary

Mr. P.C. Agarwal, Engineer-in-Chief

Mr. M.S. Sohoni, Chief Engineer, Survey & Investigation

Mr. V.K. Jadwani, Superintending Engineer, World Bank Project Circle (in charge of Kaliasote Project)

Mr. K. Ambaji Rao, Superintending Engineer, Kolar Project Circle

BODHI

Mr. O.N. Thapar, Chief Engineer, BODHI

Mr. R.R. Pandit, Ex-Director, Canal

Mr. S.C. Chatterjee, Director, Dam

Mr. Naseem Zaheer, Director, Dam Safety

Mr. D.C. Jain, Director, Gates

Mr. T.W. Hingankar, Director, Hydrology

Mr. P.S. Kulkarni, Director, Irrigation Research

Mr. K.C. Gupta, Director, Rates & Costs

Mr. P.M. Kamble, Director, Specifications

Mr. K.I. Sankpal, Deputy Director, Computer Cell

Narmada Valley Development Authority

Mr. D.V.S.R. Sarma, Chief Engineer Design & Acting Member Planning

APPENDIX C -- LAB EQUIPMENT

The following list of laboratory equipment on hand, on order, and desired were provided by BODHI.

LIST OF EQUIPMENTS AVAILABLE IN SOIL & MATERIAL LABORATORIES BHOPAL, RAIPUR AND JABALPUR MATERIAL TESTING.

Sl. No.	Name of Equipment	Soil & Material Testing Laboratory Bhopal.	Soil & Material Testing Laboratory Raipur.	Soil & Material Testing Laboratory Jabalpur.	Remarks for Coln. No. 3
1.	2.	3.	4.	5.	6.
1.	Compression Testing Machine				
	A - 200 Tonne Cap.	1 No.	-	-	
	B - 100 Tonne Cap.	1 No.	1 No.	1 No.	
	C - 50 Tonne Cap.	2 No.	-	-	
	D - 25 Tonne Cap.	-	-	1 No.	
2.	Abrasion Testing Machine	1 No.	-	1 No.	
3.	Attrition Testing Machine	1 No	1 No.	-	
4.	Crushing Value Test Appts. (7.5, 15 & 30 cm dia)	1 Unit	1 Unit	1 Unit	
5.	Impact Test Apparatus	2 Nos.	1 No.	1 No.	
6.	Ball Mill	1 No.	1 No.	-	
7.	Compacting Factor Appts.	1 No.	-	1 No.	
8.	Slump Test apparatus	2 Nos.	2 Nos.	2 Nos.	
9.	Mortar Permeability Test Apparatus	1 No. (Set of Six)	-	-	
10.	Concrete Permeability Test Apparatus	1 No. (Set of Three)	-	-	
11.	Muffle Furnace	1 No.	1 No.	-	
12.	Air-Entrainment Meter				
	(A) 0.005 M^3 Cap.	1 No.	-	-	
	(B) 0.01 M^3 Cap.	1 No.	-	-	
13.	Accelerated Curing Tank	4 Nos.	1 No.	-	
14.	Normal Curing Tank	4 Nos.	1 No.	-	
15.	Le-chatilier Flask	4 Nos.	4 Nos.	-	

Contd.....2/=

1.	2.	3.	4.	5.	6
16.	Le-chatilier Apparatus for Soundness	4 Nos.	4 Nos.	2 Nos.	
17.	Blains Air permeability Test Apparatus	2 Nos.	2 Nos.	2 Nos.	
18.	Platinus Crucible	3 Nos.	1 No.	-	
19.	Vibrating Table	2 Nos.	1 No.	1 No.	
20.	Vibrating Needle	1 No.	-	-	
21.	Distillation Plant	2 Nos.	2 Nos.	1 No.	
22.	Rapid Moisture Meter	1 No.	2 Nos.	1 No.	
23.	Concrete Mixer	2 Nos.	1 No.	1 No.	
24.	Vee-Bee Consistometer	1 No.	-	-	
25.	Laboratory Jaw Crusher	1 No.	-	-	
26.	Flow Table for Mortar	2 Nos.	2 Nos.	1 No.	
27.	Flow Table for Concrete	1 No.	-	-	
28.	Vicat Apparatus	2 Nos.	2 Nos.	3 Nos.	
29.	Mortar Mixer	1 No.	1 No.	-	
30.	Tensile Testing Machine	1 No.	-	-	
31.	Jolting Apparatus	1 No.	-	-	
32.	Rock Cutting Saw	1 No.	-	-	
33.	Heat of Hydration Apparatus	1 No.	-	-	
34.	B.O.D. Incubator	1 No.	-	-	
35.	P.H. Meter	1 No.	-	-	from C.B.I.P.
36.	Spectro Colorimeter	1 No.	-	-	from C.B.I.P.
37.	Turbidity meter	1 No.	-	-	from C.B.I.P.
38.	Conductivity Meter	1 No.	-	-	
39.	Auto Clave	1 No.	-	-	
40.	Aggregate Polishing Machine	1 No.	-	-	
41.	Transverse Strength Appts.	1 No.	-	-	
42.	Mortar Penetrometer	1 No.	-	-	* Order Placed, Machine received but under acceptance after repair.
43.	Flexural Strength Testing Machine for Canal lining tiles.	1 No. *	-	-	

1.	2.	3.	4.	5.	6.
44.	Bactreological Incubator	1 No.	-	-	From C.B.I&
45.	Pathalkotes Kit for Water Testing	1 No.	-	-	From C.B.I&

Assistant Research Officer
Directorate of Irrigation Research
Bhopal (M.P).

List of Equipments/Instruments available with Hydraulic Laboratory at Hathaikheda Research Station.

Sl. No.	Name of Equipment	Number	Remarks
1.	Levelling Instrument	3 Nos.	-
2.	Hand Drilling Machine (Wolf make)	1 No.	-
3.	Centrifugal Pump (60 H.P)	3 Nos.	-
4.	Centrifugal Pump (5 H.P)	2 Nos.	-
5.	Centrifugal Pump (30 H.P)	3 Nos.	-
6.	Water Pump (1 H.P)	1 No.	-
7.	Compressor	1 No.	-
8.	Spray Painting Gun	1 No.	-
9.	Slotted Angle Cutter	1 No.	-
10.	Pigmy Current Meter	1 No.	-
11.	Camera (Yashica 635)	1 No.	-
12.	Flash Gun	1 No.	-
13.	Oven Big size for Acrylic Moulding	1 No.	-
14.	Pointer Gauge	12 Nos.	-
15.	Prandtl tubes	12 Nos.	-
16.	Mano meter	6 Nos.	-
17.	Heat sealing equipment	1 No.	CBIP
18.	Thickness Gauge	1 No.	CBIP
19.	Tensile Strength & Elogation Equipment	1 No.	CBIP

List of Equipment available in Bhopal, Raipur and Jabalpur Laboratories Soil Testing.

Sl. No.	Name of Equipment	Soil & Material Testing Laboratory Bhopal.	Soil & Material Testing Laboratory Raipur.	Soil & Material Testing Laboratory Jabalpur.
1.	Triaxial Shear machine	9	10	1 No.
2.	Swell Pressure Apparatus	12	2	-
3.	Compaction Test Apparatus	4	4	4
4.	Limit Test Apparatus	4	2	2
5.	Shrinkage Test Apparatus	2	1	-
6.	Grain size Analysis Appts.	2	2	2
7.	Permeability Test Appts.	4	12	6
8.	Relative Density Test Appts.	1	-	-
9.	Consolidation Test Appts.	1	1	-
10.	Box-Shear Machine	1	1	-
11.	Penetrometer	3	1	3
12.	North Decota Cone	-	1	-
13.	Permeability and settlement Test Apparatus	2	2	-
14.	C.B.R. Test Apparatus			
	(A) Lab. Type	1	-	-
	(B) Field Type	1	-	-
15.	Puris-Siltometer	-	1	-
16.	Abotts compaction kit	-	2	-
17.	Unconfined compression Test Appts.	1	1	-

List of Equipments/Instruments for which Estimate has been Sanctioned.

Tenders yet to be floated.

Sl. No.	Name of Equipment/Instrument	No.	Remarks
1.	Vertical Bend saw	1 No.	For Hyd. Lab. Bhopal.
2.	Wood working lathe	1 No.	-do-
3.	Thickness Planer	1 No.	-do-
4.	Fixed Circular saw	1 No.	-do-
5.	Padestal Grinder	1 No.	-do-
6.	Vertical Drill Machine	1 No.	-do-
7.	Bench Drill Machine	1 No.	-do-
8.	Water Cooler	1 No.	-do-
9.	Gas Mask	2 Nos.	-do-
10.	Oil & Water Constant Pressure System for Triaxial Shear Test	1 No.	For S & M Lab. Jabalpur.

Total amount of Estimate Rs. 1.19 lakhs.

LIST OF EQUIPMENT FOR STRENGTHENING OF RESEARCH AND TESTING FACILITIES UNDER BODHI

(Approved for procurement under USAID)

S.. No.	Name of Equipment	Purpose	Approx. Cost Rs. in lakhs	Remarks
1.	2.	3.	4.	5.
(A)	For Upgrading of Hydraulic Model Testing Unit			
1.	Cutting and joining equipment for acrylic sheet.	For making model components like pier, gates chute blocks, divide walls, profile, sluice and other such structure in acrylic material. (1 No. x 10000/-)	0.10	
2.	Digital Water level recorder	To read water level is Model (6 Nos. x 10,000/-)	0.60	
3.	Current meter with strip chart recorder	For measuring velocities at various points (6 Nos. x 15000/-).	0.90	
4.	Digital display for triaxial shear equipment.	Direct recording for avoiding manual error (6 Nos. x 75,000/-).	4.50	
(B)	Upgrading of Soil Testing Unit :-			
5.	Soil lathe	Trimming and preparation of soil samples (L.S)	0.10	
6.	Deionizer	For Deionized Water in Lab (L.S.).	0.10	
7.	Pressure meter for soil load deformation	Insitu Test (L.S.)	0.75	
8.	Static cone Penetrometer	For bearing capacity of soils (L.S.)	0.50	
(C)	Upgrading of Material Testing Units :-			
9.	Humidity Control	To keep samples at desired temperature and humadity (6 Nos. x 15000/-).	0.90	
		C.O	8.45	

1.	2.	3.	4.	5.
10.	400 T Compression strength testing machine complete (Crushing, tensile, flexural,strength with data logger concrete and rock samples 15 cm cube with 40 mm gauge aggregate).	B.F. For (C.C & rock samples testing) (1 No. x 4 lakhs).	8.45 4.00	
(D)	For Establishment of Sedimentation Unit			
11.	Current meter distance measurer	Distance measurement under Water (1 No.)	0.50	
12,	Walky O Talky sets and Binoculars	For communicatio with on board staff (2 Nos.)	0.20	
13.	Reversible water samples	To collect water samples at any desired depth (L.S)	0.40	
14.	Digital Planimeter	Accurate measurement of areas (L.S.)	0.20	
15.	Gama Probe instrument	Insitu density of deposited sediment (L.S.)	0.60	
16.	Steel Boat 6 m with I.B. engine (30 H.P)	For Traversing rant lines during Hydrographic survey (1 No. x 3 lakhs).	3.00	
17.	Distomat 15 Km range	For measuring distance during taking soundings accurately (1 No. x 1.50 lakhs).	1.50	
18.	Echo Sounder of high sensivity & capacity	For measuring depth upto 60m for taking sounding in reservoir (2 Nos. @ Rs. 1.40 Lakhs).	2.80	
19.	Miscellaneous	For Accessories etc.	0.40	
		Total Rs.	22.05	
		Add for Transport etc	0.95	
			23.00	

(Rs. 23.00 lakhs).

LIST OF ADDITIONAL EQUIPMENTS REQUIRED

Sl.	Name of Equipments	Quality	
		Imported	Indegenous
1.	2.	3.	4.
	(A) Hydraulic Model Testing		
1.	Acrylic Sheets for Model Making	L.S.	-
2.	Transducers	Ten	-
	(B) Hydraugraphic Survey for Sedimentation		
1.	Binoculars	-	Four
2.	Miscelleneous		
	Accessoires of Sedimentation equipments		Lump Sum.
3.	Echo Sounder 0 to 100 m	One	-
4.	Walki Talkie (Long Range)	Five	-
	(C) Photo Elastic Unit		
1.	Diffused light Polariscope with loading fan	One	-
2.	Analoguer Field Plotter)		
3.	Dabinets compensator)	One	-
4.	Hilt schars Lateral Extensometer)		
5.	Tele O Microscope)		
6.	Aerylic sheets for mould)		

Sl. No.	Name of Equipment	Costs	
		Imported	Indegenous
	(D) Electrical Analogy Unit		
1.	Electronic Analoguar field plotter with table.	One	-
2.	Conductivity sheet on Tele data Paper	L.S.	
	(E) Rock Testing Unit.		
1.	Bore Hole Logger with 8 probes including cables, Geophones, print out etc.	One	-
2.	Dilatometer	One	-
3.	Flat Jack including rock saw & cutter (1.5 m x 1 m)	One	-
	(F) Photo elastic Units		
1.	Photographers Camera with accessories	-	One
2.	Work shop equipments	-	One Unit
3.	Developing and Printing Unit	-	One Unit
	(G) Petrological Testing Unit		
1.	Stereo Projection microscope with camera	-	One
2.	Stereo Microscope	-	One
3.	Grinder, slides polishing etc.	-	One Unit
	(H) Instrumentation Calibration Units		
1.	Displacement Transducers with Rend out units	-	Five with one read out limit
2.	Diat gauge Calibration Tester with accessories	-	One
3.	Dial gauge, Pressure guage meter with master gauge	-	One
4.	Proving Ring Calibration Tester with gauges	-	Five
5.	Piezometer Testing Unit	-	One
6.	Temperature measurement calibration with Oven	-	One kit
7.	Stress & strain Transducers calibration unit.	-	One Unit

APPENDIX D -- OFFICE EQUIPMENT

The following list of desired office equipment was provided by BODHI.

EQUIPMENT FOR DESIGN WING

1. Design Organisation :

1.1 Office equipment :

a)	Furniture for computer room, data storage and retrievel	
b)	Plain paper copier Jumbo size with capacity for enlargement and reduction	1
c)	Plain paper copier ordinary size	1
d)	Electronic Stenciller	2
e)	Electronic Typerwriter	2
f)	Internal communication equipment with electronic PABX system	
g)	Electric Duplicator (Big size)	1
h)	Electric Duplicator (Small size)	2
i)	32 bid mini compute with printer, plotter, Digitizer, nodem and other peripherals	1
j)	Electronic Draughting system with printer and other peripherals	2
k)	Air conditioner I.S T	10
l)	Computer mapping and Geographic information management system	1
m)	Soft-ware for the above computer system, Word processor, spread sheet, High level language compilers, data base management Analysis, Auto CAM GIS, and specialised software of Hydrologic models, simulation models, optimisation models pertaining to irrign. management etc, etc.	
n)	Other miscellaneous equipment for modernisation of Design office	

TRAINING AND SEMINAR EQUIPMENT AND MATERIALS

1.	Audio equipment such as microphones, speaker, emplifiers, Tape recorders, record player etc.,	
2.	Visual display equipment :	
	- Over head projector	2
	- Epidio scope	2
	- Slide projector Automatic	2
3.	Audio - visual equipment :	
	- 27" TV with VCP with stabilizer etc.	1
	- 8 mm projector with sound equipment	1
	- 8 mm projector with sound equipment	1
4.	Photographic equipment :	
	- Still Camera	1
	- Video Camers	1
5.	Self paced Video training counts (as per list enclosed)	
6.	Slide sets with Seroph (As per list enclosed)	
7.	16 mm movies (as per list enclosed)	
8.	8 mm movies (as per list enclosed)	
9.	Simulation Games, Management exercises etc.,	
10.	Other Miscellaneous training materials	

APPENDIX E -- TRAINING ACTIVITIES

The following lists of training activities were provided by BODHI.

LIST OF SEMINARS, WORKSHOPS & TRAINING COURSES ATTENDED BY OFFICERS OF BODHI ABROAD

Sl.	Name of Officer	Designation	Purpose of foreign tour	Title of Training/ Seminar/Work shop/ Tour	Period	Month & year of visit	Name of countries visited
1.	Shri O.N. Thapar	Chief Engineer	Work-shop	Planning, policy and strategies in irrigated agriculture	2 weeks	Dec.'88	USA
2.	Shri P.S. Kulkarni	Director	Work-shop	On field irrigation design evaluation and scheduling	7 weeks	Dec.'88	USA
3.	Shri D.K. Shrivastava	Dy. Director	Study tour	System engineering project under UNDP fellowship	8 weeks	Jan.'86	USA and Yugoslavia
4.	Shri Shyam Sunder	Dy. Director	Study tour	System engineering project under UNDP fellowship	8 weeks	Jan.'86	USA and Yugoslavia
5.	Shri K.I. Sankpal	Dy. Director	Training	On field irrigation design evaluation and scheduling	6 weeks	May.'87	USA
6.	Shri Balraj Singh	Dy. Director	Training	Irrigation practices and problems	8 weeks	June'87	USA
7.	Shri V.K. Pare	Dy. Director	Training	Irrigation practices and problems	8 weeks	June'87	USA
8.	Shri S. Khan	Dy. Director	Training	On field irrigation design evaluation and scheduling	7 weeks	May'87	USA
9.	Shri A.V. Khare	Dy. Director	Training	Irrigation practices and problems	8 weeks	June'88	USA
10.	Shri J.K. Tiwari	Dy. Director	Training	Irrigation practices and problems	8 weeks	June'88	USA

LIST OF TRAINING COURSES/WORKSHOPS/ SEMINARS ATTENDED BY OFFICERS OF BODHI

1. Post Graduate Diploma/Master of Engineering(M.E). courses in Water Resources Development at the Water Resources Development Training Centre (W.R.D.T.C.) Roorkee.

2. Post Graduate Diploma/ME course in Hydrology at Roorkee.

3. Post Graduate Diploma/ME courses in Water Use Management at W.R.D.T.C., Roorkee.

4. A short term course in Hydraulic Models at Roorkee.

5. Workshop on "Data storage and retrieval system" held at the National Institute of Hydrology (N.I.H) Roorkee.

6. Workshop on reservoir operation at NIH, Roorkee

7. Workshop on "Plasticulture development at the Gujarat Engineering Research Institute, Vadodara.

8. Design, construction and maintenance of masonry dams at the Academy of Administration, Bhopal.

9. Geological in-varities and foundation treatment, at the Academy of Administration.

10. Refresher course for diploma holder Assistant Engineers at Academy of Administration.

11. Tender, claims and arbitration at Academy of Administration.

12. Operation of canal system at Academy of Administration.

13. Design, construction and maintenance of earth dams at Academy of Administration.

14. Hydrometeorological investigations and stream gauging at Academy of Administration.

15. Operation and maintenance of irrigation distributary system at Academy of Administration.

16. Hydrology - Academy of Administration.

17. Refresher & special course on computer aided design of gravity dams at Continuing Education Department, Roorkee.

18. Remote sensing and photogrmmetry for engineers at Continuing Education Department, Roorkee.

19. Short term course on research analysis and instrumentation for hydraulic structures at CWPRS, Poona.

20. Design of diversion structures, WRDTC, Roorkee.

21. Water use management, WRDTC, Roorkee.

22. Ground Water Management, WRDTC, Roorkee.

23. Training opportunity in remote sensing training course at NRSA, Hyderabad.

24. Refresher course on prestressed concrete and mix design at Continuing Education Department, Roorkee.

25. Refresher course on environmental management and impact assessment and economic appraisal and monitoring at Continuing Education Department, Roorkee.

26. International symposium on New technology in model studies in hydraulic research.

27. Seminar on application of system analysis for development of water resources C.B.I.P., New Delhi.

28. International symposium on new materials and techniques in dam construction, Madras.

29. All India seminar on earth and rockfill dams at Lucknow.

30. Second international colloqium on concrete development, Bombay.

31. National symposium on remote sensing in land transformation and management.

32. Symposium on quality management, quality assessment and quality control in water resources and power engineering.

33. First national water conservation, C.B.I.P.

34. National symposium on hydrology, HILTECH.

35. I.S.T.E. winter school on hydraulic lab., flow and fluid mechanics - Roorkee.

36. 54th Annual R&D session of C.B.I.P., Ranchi.

37. Seminar on utilisation of irrigation potential and crop pattern for Barna, WALMI Bhopal

38. Seminar on conjunctive use of water, WALMI Bhopal

APPENDIX F -- FUTURE TEAMS

SPECIALISTS FOR STRENGTHENING BODHI

1. SCOPE OF WORK

Three teams of specialists consisting of one Indian and one U.S. specialist will be formed for a period of 2 to 4 weeks to work closely with BODHI. The primary objective is:
- to improve and strengthen the capabilities of BODHI in the fields of (1) Geotechnical field and laboratory investigations; (2) Hydrology; and (3) Hydraulic modeling.

The specific responsibilities will include:

- Carry-out detailed discussions with Department of Irrigation specialists to review the current methods and available equipment.

- Assess requirements of equipment and trained staff for the anticipated workload.

- Prepare a detailed program on-the-job training for these special fields.

- Prepare and discuss the draft report with BODHI's Officers and then finalize the report.

2. Qualifications

A. Geotechnical Specialist

- Degree in Civil/Geotechnical Engineering

- Professional Engineering Registration

- 15 years experience in performing geotechnical sampling

- Professional communication skills

B. Hydrologist

- Degree in Civil Engineering/Hydrology

- Professional Engineering Registration

- 15 years experience in hydrologic investigations and analysis

- Water resource development experience in tropical/sub-tropical countries

- Professional communication skills

C. Hydraulic Modeling Specialist

- Degree in Civil Engineering

- Professional Engineering Registration

- 15 years experience in a large laboratory conducting hydraulic model testing of dams, barrages, canal structures, and river behavior

- Professional communication skills

- Experience with computerized data acquisition systems desired

APPENDIX G -- NOTE FOR REVIEW OF WORK OF BODHI

The following Note describing the work of BODHI was prepared August 1, 1988.

NOTE FOR REVIEW OF WORK OF BODHI

1.0 ADMINISTRATIVE

1.1 A Bureau of Design for Hydel and Irrigation Project (BODHI) has been constituted vide Govt order No.2/29/83/P/31 dated 7.6.85 for the proper planning and design of irrigation projects.

1.2 In the 1st phase of BODHI, 6 Directorates headed by one Chief Engineer has been establisished by merging the Central Design Organisation,Testing Organisation,Specification Directorate, Dam Safety Cell and extra formation sanctioned vide Govt order referred above. The six directorates established are as below :

(i) Dam & Hydrology
(ii) Irrigation canal & Barrage
(iii) Rates & Costs .
(iv) Specification & Standardisation
(v) Dam Safety
(vi) Irrigation Research

1.3 Subsequently vide Govt Order No 2/37/87/P/31 dated 22.7.87 the Dam & Hydrology Directorate was bifurcated into two seperate Directorates, namely Dam Directorate and Hydrology Directorate by redeploying the Engineering & Hydrological Circle,Bhopal under Chief Engineer, Ground Water.

1.4 At present the Bureau of Design for Hydel & Irrigation Project is headed by the Chief Engineer with 7 functional Directorates headed by the officers of the rank of Superinteding Engineer. The position of sanctioned formations and the vacant posts is given in Annexure - I

1.5 The budget allotted for the year 1987-88 was Rs 105.94 lakhs against which expenditure incurred was Rs. 93.28 lakhs. The main reasons for short fall in expenditure were

- Non filling of vacant posts.
- Savings in T.A , M.R., telephone charges etc.
- Non purchase of books and journals,drawing instruments etc. in comparison to revised budget demand.

In addition an amount of Rs. 21.50 lakhs was received by the D.I.R from the allotments of major projects against which an expenditure of Rs 12.82 lakhs was incurred which includes the expenditure on research studies of CBIP also.

The budget allocation is Rs. 30.29 lakhs till 9/88 against the demand of Rs. 181.12 lakhs during the year 88-89 as per details given in Annexure II. The expenditure incurred upto 6/88 is Rs. 25.13.lakhs.

2.0 Important activities connected with the building up of the organisation.

2.1 Planning and construction of permanent BODHI buildings (Residential and non-residential)

It is proposed to construct BODHI Building with residential quarters on the right bank of Kaliasote reservoir to the right of Kaliasote spillway. The site has been identified and S.E. Betwa Circle,has been asked to take action for its acquisition. The job of planning of the buildings has been entrusted to EPCO by the Chief Engineer (C/B). Planning has to be made for the present as well as for future. Close interaction with C.E.(C/B) and EPCO is very necesssary. N.O.C. from Town & Country Planning Department has been obtained. The land acquisition case is being pursued by S.E Betwa Circle. As per latest direction of Collector , the S.E.has submitted case to him on 5.10.87 for acquisition of private land as under:

i. Chandanpur village	-	78.61 ha.
ii. Damkheda village	-	51.10 ha.
		129.71 ha.

The case for Government land is also under correspondance and has been sent finally to S.D.O. (Civil) Capital Project on 20.10.87 by the Executive Engineeer Irrigation Dn. Bhopal . Agenda note for construction of buildings for Phase-1 has been submitted by Chief Engineer (C/B) and is still under consideration of P.R.C.

2.2 Strengthening of BODHI

The proposals for strengthening of BODHI was framed and submittted to USAID for financial assistance. The USAID has agreed to finance the purchase of Design, Research & Training equipment worth about $4,00,000 Dollars purchase of books worth about 25,000 US Dollars,Membeership of professional Institutions and subscriptions of journals for a period of four years limited to 7,500 US Dollers. List of books,membership of institutions and Journals costing Rs. 3 28 lakh has been approved by the Govt. of MP vide their letter Dt. 2.6.88 . The list of equipment costing Rs. 17 lakhs to be procurred for Design, Training and Research has also been finalised.

Training of BODHI personnel in USBR is one of the components of strengthening. Discussions have been held with USBR/USAID officeers. Four officers (D.D & above) of BODHI have to be identified their levels quantified, training requirement specified and the case has to be sent to USAID after approval from GOMP. These details are under finalisation.

2.3 Training of BODHI personnel in the country/ abroad.

BODHI officeers are being sent for training in the Country on the basis of training proposals / refresher courses etc. received from various organisations from time to time.

One Director and 5 Dy. Directors of BODHI have already gone abroad under USAID/UNDP training programme. At present two Dy. Directors are

under training in U.S.A. The names for proposing personnel for training abroad are being dealt by SCC/IFC. As regards training of BODHI personnel in USBR, the position is indicated under item 2.2 above.

2.4 Computer programmes

At present BODHI has one computer PC Apple - Macintosh. For this computer following softwares are available :

(i) Spread Sheet
(ii) Word Processor
(iii) Data base (Helix)
(iv) FORTRAN and BASIC

The utilisation of these softwares done so far is as indicated below.

2.41 Spread Sheet - The pay bills,GPF schedules, deduction details regarding house rent, grain advances, GIS, festival advances etc. of BODHI officers and officials have been prepared. The details of rate analysis have also been prepared on the same.

2.42 Word processor -Specifications for Irrigation works (8 chapters) have been fed.

2.43 Data Base (Helix) - Directory of Dams and status report of different projects, reviewed by BODHI, have also been prepared and stored.

2.44 FORTRAN - 34 programmes on hydrology, design of masonry, earth dam, computation of ETO by various methods etc. have been prepared . A list of programmes is enclosed vide Annexxure III. At present a programme on "Reseervoir operation studies", is under preparation.

2.45 BASIC - Printout of 3 programmes have been obtained from WALMI, Aurangabad. Out of these, 2 programmes have been tested successfully on our computer. In all 8 programmes are stored in our computer

3.0 Important activities connected with improving technical standard of support to department -

3.1 Preparation of design manual and issue of Technical circulars -

Earlier, it was decided to review old technical circulars and also issue new technical circulars on subjects not covered under the old ones issued by the Department. Around Sept.- Oct. '86, it was felt that issue of technical circulars in piecemeal may lead to contradiction or confusion. It was therefore, decided to prepare a design manual Accordingly a list of chapters to be included in the Design Manual and the Directorates responsible for preparing the same was prepared and approved. The draft for following two chapters of this Manual have been prepared and are under finalisation.

i) Preparation of project report and estimates;

ii) Dam Safety.

However, subsequently it was felt that preparation of these chapters is likely to take long time in view of increasing work load in BODHI, it was, therefore, decided that technical circulars on topics of emergent nature may be prepared and issued in the first instance.

So far 21 technical circulars have been issued by BODHI on subjects listed at Annexure-IV.Drafts for 8 technical circulars as listed at Annexure-V have also been prepared. These are under process of finalisation.

3.2 Finalisation of specifications of works

Finalisation of specifications of works involves activities of drafting, review by BDC, review by BODHI, printing of draft specifications, receiving comments of field formations , preparation of final draft for specifications and printing. The position in respect of each is indicated below :

3.21 Earlier specifications for 36 chapters were to be drafted. Subsequently, it was decided that it is not necessary to draft the specifications for Ch. 42-Field testing and Ch. 44-instrumentation. out of balance 34, drafting for 29 chapters have been completed. For remaining 5 chapters (Ch. no. 2, 30 to 33) position of drafting is as below :

Chapter No. 2 - The draft of this chapter is in the final stage.

Chapter 30 to 33 pertain to item of water supply and work entruusted to Shri V.C. Mandlekar, Chief Engineer, P.H.E. Department for drafting.

3.22 Review by BDC : Out of 29 chapters drafted, review by BDC has been done for 28 chapters. Review of chapter No. 23 is yet to be received from BDC.

3.23 Review by BODHI: Out of 28 chapters reviewed by BDC, 26 chapters have already been reviewed by BODHI. 2 Chapters which have been reviewed by BDC are required to be redrafted and are programmed to be completeded by Sept '88.

3.24 Printing : Out of 26 chapters finally reviewed by BODHI, 16 chapters have been printed and sent to the field formations for comments. Two more chapters are under printing and the balance 8 chapters are under process for sending to the press for printing.

3.25 Preperation of final draft of specifications.: The activities indicated in para 3.21 to 3.24 cover the aspects of preparation and circulation of draft specification. These draft specifications are to be finalised after receiving comments from various officers. 11 Chapters (4,6,7 8A, 8B, 9, 10,11,16,17, 21 &29) were sent to the field formations for their comments vide E.in-C's D.O. letters dt. 25.5.87, 30.7 87, 28,9,87, 21.10.87 & 19.11.87. They were finally given a date of 31.11.87. to recieve comments in BODHI vide E.in-C D.O. letter dt. 19.11.87 . This date was further

extended to 31.3.88 vide C.E BODHI D.O.letter dt. 6.2.88 , but practically no comments have been received. Further five more chapters (14,18,19,13 &15) have also been circulated vide E-in.-C's D.O letter dt. 19.4.88 and 6.7.88 and final dates for receiving comments in BODHI are 30.6.88 and 31.8.88 respectively. So far comments of 3 field officers on chapter 4, 8, 9 & 29 have been received. It is, however, considered necessary that the comments at least some of the experienced senior level officers on this job should be received before these are finalised.

3.3 Review of schedule of rates

The Govt. of M.P. Irrigation Department, Bhopal has desired to revise the rates of various chapters of USR ' 84 due to rise in rates of labour and materials vide GOMP D.O. No. 22/28/83/ Medium/ 81 Bhopal, Dt. 20.11.86. In view of the above the labour and daily wages rates of various cateegories have been finalised on the basis of rates sanctioned by Rewa , Bilaspur, Raipur, Jabalpur, Indore and Bhopal Commissioners, w.e.f. 1.1.87. Accoordingly, rates of chapters 4&5 of USR '84 have been prepared. Details of 3 chapters have been fed in the computer.

3.4 Issue of amendments/clarifications:

8 Nos. references on USR and specifications were recieved from various organisations like A.G., C.T.E. and C.Es. These were critically examined and necessary replies / clarifications / amendments have been issued.

4.0 Special studies under USAID MP-MIS

4.1 Sedimentation study

As per approval accorded by USAID vide their letter dt. 21.1.85 for the proposal of "determination of rate of sedimentation in M.P. MIS" Special study has been conducted . Following five reservoirs representing the various Agroclimatic zones of Narmada valley were selected for the study.

i. Hathiakheda tank Distt. Bhopal,
ii. Dukrikheda tank Distt. Hoshangabad.
iii. Dhuandhar tank Distt. Mandla,
iv. Kunda tank Distt Dhar,
v. Sakalda tank Distt Dhar,

The field data has been analysed and an emperical formula devised to work out the sedimentation rate in cum. per year taking into consideration the following important parameters responsible for the soil erosion /sedimentation..

(i) Catchment area use,
(ii) Average weighted gradient of the catchment,
(iii) Average monsoon rainfall,
(iv) Shape of the catchment

Efforts have also been made to suggest distribution pattern of sedimentation accumulation in dead and live storage zones and a formula evolved for the same.

The report has been finalised and will be issued by August '88.

4.2 Rainfall-runoff relationship for various agroclimatic zones-development of model.

The development of tank model by IIT for Banchhor tank in Distt Raisen (agroclimatic zone no. 3) has been completed and the report has been received. This report has been sent to E.in.C on 22.12.87 for onward transmission to USAID. The development of models for other tanks would now be undertaken in BODHI after receipt of detail computer programme from IIT.

In addition to the above mathematical model, attempt is being made to develop rainfall- runoff relationship after taking into account the catchment and rainfall characteristics. This exercise is being done with respect of Segwan tank in Khargone district (agroclimatic zone no. 5).

5.0 Studies connected with dam safety aspects of a few important projects

5.1 Review of the dam safety aspect of Pagara, Kotwal and Pillowa dams.

The position of Geological, Hydrological and Structural investigations and proposals for rehabilitation is as under:

5.11 Geological investigation: Geological investigation have been entrusted to CSMRS. The report for Kotwal and Pillowa dams has been received.

5.12 Hydrological investigations: The design flood has been finalised by C.W.C. as under:

Pagara	6530 cumecs (PMF)
Kotwal	10557 cumecs (PMF)
Pillowa	7283 cumecs (SPF)

The DRP has yet to take decision on design flood to be adopted.

5.13 Rehabilitation proposals:

Pagara: Stability analysis for N.O.F. section based on latest I.S has been done with different values of PMF and MWL. Final PMF value has been received from CWC as 6530 cumecs in June '88. Revised stability analysis has also been completed for the corresponding MWL. Various alternatives for its rehabilitation have also been studied and draft technical memorandum is under finalisation.

Pillowa Tentative rehabilitation proposals for this tank were worked out prior to June 1988. Flood routing for accommodating the SPF as 7283 cumecs received from CWC is under progress. The test results of Pillowa earth dam section have been received from CSMRS. These have been examined and the required data has been asked from the field formation for further checking the stability of slope of dam section.

Kotwal weir: Rehabilitation proposals for revised PMF of 10,557 cumecs are under study.

5.2 Review of dam safety of Bango Dam & Hasdeo barrage:

The PMF has been finalised by CWC in collabration with BODHI is as

42,842 cumecs. The DRP (6/88) has suggested raising of dam by one metre.

5.3 Flood study of Gandhisagar dam: The phase I study of flood for Gandhisagar dam has been completed by CWC in collobration with BODHI in April 1988. The PMF has been worked out as 67,670 cumecs against values of 39,780 cumecs considered so far.

5.4 Flood study of MP Medium projects- World Bank Aided

The design memorandum (flood) of 16 projects of World bank aided MP Medium projects have been scrutinised and got checked by the DRP. The work includes the preparation of draft design memorandum, scrutiny and editing of memorandum received from the field formations.

6.0 Specific cases referred to BODHI

6.1 Design : Six cases of design were referred to Dam Directorate of BODHI by the field formations. Out of these specification drawings for four cases and construction drawings for two cases have been prepared and issued. Three casas are under various stages of progress.

6.2 Design of radial gates of Kaliasote, Larpur and Halali pump house projects received from C.Es., have been checked and returned back with final observations. The case of radial gates for Dholawad tank, stop log gate for Kolar project and Bargi RBC sluice gate are under checking.

6.3 Revised administrative approval

The position is as under :

S.No	Type of Projects	No.of Projects received in BODHI	Observation note sent for compliance	Compliance of observation note done by Field staff	Cleared by TAC
1.	Major projects	3	3	-	-
2	Medium projects				
	World bank aided	11	11	2	1
	Other than World bank aided	4	4	-	-

6.4 Project examination

The position is as under :

S.No	Type of Projects	No.of Projects received in BODHI	Observation note sent for compliance	Compliance of observation note done by Field staff	Finally Cleared
1	Major	5	4*	1	-
2	Medium	9	7	-	-

* Arpa project is under examination in CWC.

6.5 Cases of Technical Advisory Committee:

Eight cases of TAC were referred by the field formations. Out of which 7 cases have been finally disposed off.

6.6 Hydraulic model studies ;

Hydraulic model studies of following projects are with the research directorate. The present status of these cases is given in Annexure -VI

i) 2-D and 3-D model of Indira sagar project
ii) 2-D and 3-D model of Maheshwar project
iii) Hasdeo Bango project (stage construction studies)
iv) Bansagar
v) 2-D and 3-D model of Sondur project
vi) 2-D of Gambhir project
vii) 3-D model of Ruthai project
viii) 3-D model of Sikkasar project
ix) 2-D model of Kolar project
x) Bhadbhada spillway, 3-D model - back water effect of Kaliasote project
xi) 2-D model of Mahi project
xii) Mahan Project

6.7 CBIP sponsored studies:

Following research studies of CBIP are under various stages of progress.

i. Problems in training of small stream in hydraulic structures.
ii. Environmental effect of water resource project (Tawa Dam).
iii. Study of morphology of incised river in MP
iv. Sedimentation studies of Gandhisagar Dam (Repeat survey)

v. Sedimentation studies of Tawa dam
vi. Leaching of lime from Gandhisagar, Tawa and Barna dam.
vii. Study of Environmental impact of utilisation of trace elements contaminated water in irrigation and development water quality criteria.
viii. Studies related to plasticulture development center (PDC)

6.8 Material & Soil testing:

Routine and special test on soil and material are under taken by the soil and material testing laboratory at Bhopal and Jabalpur. Basic concrete mix designs for Narmada sagar and swell pressure of soils are also conducted in these laboratories.

6.9 Cases of other department

Following cases of other departments have also been scrutinised and disposed off.

i) Central spillway of Pench valley (PHED).
ii) Chirmiri water supply scheme (PHED)
iii) Water supply project for Dewas town (PHED)

7.0 Activities of dam safety cell

7.1 Safety evaluations and inspection of the following 18 dams were carried out by the Director Dam Safety and inspection note issued.

i)	Kanhargaon	Chhindwara district
ii)	Waghy nala	Chhindwara district
iii)	Kolar dam	Sehoe District
iv)	Kaliasote dam	Bhopal district
v)	Chandora	Betul district
vi)	Bundala	Betul district
vii)	Matiyari	Mandla district
viii)	Dejla dewda	Khargone district
ix)	Tillar dam	Shajapur district
x)	Matiamoti dam	Rajnandgaon District
xi)	Chhirpani dam	Rajnandgaon district
xii)	Dudhi project	Rajgarh district
xiii)	Sanjay sagar dam	Guna district
xiv)	Budhana dam	Shivpuri district
xv)	Gopi krishnasagar dam	Guna district
xvi)	Bila dam	Sagar district
xvii)	Bargi dam	Jabalpur district
xviii)	Choral Nakheri complex.	Indore District

7.2 The preparation of directory of dams commissionery wise in M.P is also in progress. Out of 12 commissioneries, the directories of Bastar, Raipur and Bhopal have been issued and sent to field formations for verification. Final prints will be taken out thereafter. The directory of Sagar will be issued shortly. The data for other commissioneries is

being collected.

7.3 Collection of engineering data

Engineering data on 19 nos. large dams have been collected and phase-I inspection has been carried out and report issued.

7.4 Monitoring of structure behaviour of dams through instrumentations

To review the position of instruments, Tawa and Bargi dams are inspected and reports of inspection including the suggestions for improvement have been issued. The information on instruments embeded and the observation records have been received from Bargi and Bango dam.

7.5 Collection of information regarding dam in distress

About 20 reports in this respect have been received from Chief Engineers, out of which none of the dam is reported to be in distress. However dam health status is being preparad.

8.0 Miscellaneous cases :

The following miscellaneous cases have been dealt :

(a) Drainage in Tawa command .
(b) Extension of Barna canals
(c) Lining of Hoshangabad distributary
(d) Dejla-Dewada aqueduct
(e) Bargi LBMC - type canal sections
(f) Special studies on design of new Rudri barrage
(g) Hydrology of aqueduct of Datia carrier canal
(h) Estimation of hydrology for river flood of aqueduct on Bichhia river
(i) Comments on minutes of 41stmeeting of Control Board regarding lift Irrigation schemes for out of command areas in the major irrigation projects.
(j) Special study related to identification of critical lining reaches of Bargi LBC and specification for lining.
(k) Paper on selective and part lining approach was presented in Jan'88 seminar on Action Research of WALMI.

Annexure 1

SENCTIONED STRENGTH OF BODHI AND VACANCY POSITION ENDING JULY'88

Sl.No.	Name of Post	Sanctioned Strength	On roll	Vacancy
1.	2.	3.	4.	5.
Class-1				
1.	Chief Engineer	1	1	nil
2.	Superintending Enginer	7	7	nil
3.	Executive Engineer	24	23	1
Class-II				
1.	Assistant Engineer	63	59	4
Class-III				
1.	Reasearch Assistant	47	7	40
2.	Silt Analysist	5	4	1
3.	Embankment Inspector	5	4	1
4.	Lab. Assistant	16	1	15
5.	Lab. Technician	31	9	22
6.	Instument Machanic	1	1	nil
7.	Superintendent	3	1	2
8.	Assistant	9	7	2
9.	Accountant	1	-	1
10.	U.D.C.	12	14	(-)2
11.	L.D.C.	28	26	2
12.	H.D.M.	4	3	1
13.	D.M.	15	7	8
14.	A.D.M.	16	9	7
15.	Tracer	17	8	9
16.	Stenographer	11	1	10
17.	Senior Steno	2	2	nil
18.	Typiest	10	9	1
19.	Steno-typiest	10	3	7
20.	Librarian	1	2	(-)1
21	Photocopy operator	1	-	1
22	Daftari	1	1	nil
	Total	341	209	132
Class-IV				
1.	Peon	53	19	34
2.	Lab.Attendent	5	4	1
3.	Driver	2	--	2
	Total	60	23	37

Annexure 2

SUB HEAD WISE DEMAND OF CE , BODHI. DURING THE YEAR 1988- 89

Grant No.	Head of Account	Proposed in Budget Estimate for 1988 - 89 (in Rs. Lakhs)
23	2701 Direction & Executive of CE,BODHI Office	85.00
23	2701/1st Head	
	(i) Estt. of DIR	10.25
	(ii) III- Executive estt. of DIR	10.25
	(iii) CBIP	5.00
41	4702 USAID for Estt. of DIR	23.62
41	4702 USAID for work of DIR	25.00
23	4701 Model study of DIR of works	14.00
23	2701 CBIP of DIR works	8.00
	Total	181.12

Annexure 3

LIST OF PROGRAMMES AVAILABLE WITH BODHI
[FORTRAN]

S.NO	REFF.	PROG. CODE	TITLE OF PROGRAMME
1.	CWC	EARTH.DAM	Stabilty of Earth dam.
2.	NIH	FLD FREQ ANA	Flood Frequancy Analysis of annual maximum series usig Log Transformation and Power Transformation assuming transformed series follows the normal distribution
3.	NIH	ARAINFALL.INT	Interpolation of rainfall by Distance Power and Ratio method.
4.	NIH	WTD.AV.RAIN	Computation of waited average rainfall.
5.	NIH	CATCH RAIN	Estimation of mean areal precipitation (Theisen polygon)
6.	BODHI	SY.UNIT	Synthetic Unit Hydrograph based on Flood Estimation Report of CWC
7.	NIH	MISSING FLOW	Estimation of Sample Mean, Standard Deviation,Coefficient of Skewness with missing records
8.	NIH	POLY.REGRE	Polynomial Regression
9.	NIH	MULT REGRE	Multiple Linear Regrssion
10.	CWC	FLOOD ROUTING,2	Reservoir Flood Routing by Modified Pulse Method
11.	NIH	EFF.FOR	Computation of Effective Rainfall from discharge hydrograph,after separating base flows.
12.	NIH	UNIT.FOR	Computation of Unit Hydrograph of a specified duration from the direct surface runoff hydrograph after separating base flows.

2

13.	NIH	UHISO.FOR	Estimation of the Unit Hydrograph from the direct surface runoff of an isolated storm event.
14.	NIH	CLARK.FOR	Unit Hydrograph derivation using Clark's Model.
15.	NIH	SCURVE.FOR	Development of S-Curve hydrograph from T- hour Unit Hydrograph.
16.	NIH	SUPERIM.FOR	Changing the duration of Unit Hydrograph by Superimposing method.
17.	FAO.24	CROP WATER	Estimation of Refrence crop Evapotranspiration (ETo) by Modified Panman, Blanny-Criddle and Pan Evaporation methods.
18	NIH	LOSS.FOR	Separation of Uniform loss from rainfall hyetograph and base flow from Dischage hydrograph .
19	NIH	COLUH FOR	Derives the Unit hydrograph from multi-period Storm using collin's method.
20	NIH	NEWD.FOR	Computes the Unit hydrograph ordinate of new duration using S-Curve.
21	NIH	REPROD.FOR	Used for reproduction the observed direct surface runoff hydrograph and computes the various error functions based on observed and computed direct surface runoff hydrograph .
22	NIH	SYNTH .FOR	Used for computing the direct surface runoff hydrograph from the excess rainfall of the multiple period storm and unit hydrograph.
23	NIH	GAPF.FOR	Used for estimating the missing station rainfall data using Normal Ratio method.
24	NIH	DOUBLE.FOR	Checks the consistency of a particular record using double mass curve analysis.

25	NIH	THIES.FOR	Used for computing the areal average rainfall due to a storm event in the catch -ment using the Thiessen Polygon method.
26	NIH	ISO. FOR	Computes the variation of depth with area over the catchment using Isohyetal method
27	NIH	DAILY.FOR	Distributes the daily rainfall into hourly rainfall as per the choice of the SRRG and computes the average hourly rainfall .
28	NIH	VEL.FOR	Calculates the discharge from velocity measurments .
29	NIH	RATING.FOR	Used for developing the rating curve in the form of : Q = a (G-e)b .
30	NIH	GAUGE.FOR	Used for converting the given stage values into corresponding discharge values using a given rating curve in the form : $Q=a(H-H_0)b$.
31	NIH	NASHF.FOR	Used for derivation of unit hydrograph using conventional Nash Model from the Direct Surface Runoff Hydrograph an Excesss Rainfall Hyetograph of an event .
32	NIH	INTNAS.FOR	Used for derivation of unit hydrograph using Integer Nash Model.
33	BODHI	MASORY.DAM	Stability Analysis of gravity dam (non- over flow section)
34	IS.5477 (Part iv)	PK.FL	Peak flood estimation by maximum likely-hood method (100 yr, 500 yr, 1000 yr return flood)

[BASIC]

S.NO	REFF.	PROG. CODE	TITLE OF PROGRAMME
1.	Basic hyd.	DOUBLEMASS	Checking of consistency of rainfall records.
2.	Basic hyd.	FOURQUAD	Estimation of missing rainfall record by four quadrant method.
3.	Basic hyd.	INTENDUR	Depth-Intensity-Duration analysis.
4.	Basic hyd.	DEPAREA	Computation of depth with area over the catchment .
5.	Basic hyd.	UGRAPH	Computation of ordinate of unit hydrograph
6.	Basic hyd.	SCURVE	Development of "s" curve
7.	WALMI (Aurangabad)	BACK-WATER	Computation of back-water profile.
8.	WALMI (Aurangabad)	CANALSEC	Hydraulic design of canal section.

LIST OF TECHNICAL CIRCULARS ISSUED FROM BODHI.

Si No.	T.C.No.	Refrence No & Date	Subject
			Investigation Series
1.	1	Memo No. 739/BODHI/R&C dt 31.3.86	Survey Estimate
2.	2	Memo No. 740/BODHI/R&C dt.31.3.86	Revised Estimate.
			Design Series
3.	1	Memo No. 2247/BODHI/R&C /20 dt.15.11.85	Check list of data required for design of earth dam.
4.	2	Memo No. 2247/BODHI/R&C /20 dt.15.11.85	Check list of data required for design of masonry dam.
5.	3	Memo No. 2247/BODHI/R&C /20 dt.15.11.85	Check list of design cases of cross drainage .
6.	4	Memo No. 2246/BODHI/D&H/ 13/Y/85 dt 15.11.85	Estimate of Yield at verious dependabilities at project site.
7.	5	Memo No. 474/BODHI/20/ R&C/ dt 3.3.86	Provision of U/S concrete membrene in masonry dam section.
8.	6	Memo No. 933/BODHI/R&C/ dt 24.4.86	Safety of dam - review of spillway capacity.
9.	7	(T.C.No. 7 not issued)	
10.	8	Memo No. 1047/BODHI/20/ R&C/85 dt 5.5.86	Protection of u/s slopes for reservoir embankment .
11	9	Memo No. 2281/BODHI/20/ 85 dt 29.9.86	Downstream slope protection of reservoir embankment.
12.	10	Memo No. 1266/BODHI/11/ R&C/87 dt 6.5.87	Creast width of earth /rockfill dams
13.	11	Memo No. 2507/BODHI/11/ R&C/87 dt 11.7.87	Core in earth dam.
14.	9	Memo No. 2509/BODHI/11/ R&C/87 dt 11.7.87	Design series T.C. no. 9 (revised) d/s slope protection of reservoir embankment
15.	12	Memo No. 2617/BODHI/11/ R&C/87 dt 18.8.87	Provision of berms
16.	13	Memo No. 886/BODHI/36/ R&C/86 dt 3.3.88	Shrinkage / settlement allowance in earth / rockfill dam.
17	14	Memo No. 2447/BODHI/11/ R&C/87 dt 8.7.88.	Benching /stripping / ploughing and forrowing for canal embankments.

			Construction series
18.	1	Memo No. 1621/BODHI/20/ R&C/85. dt 16.7.86	siting of canal on steeply sloping sidelong ground.
19	2		Safty during construction - special precautions to be taken while doing deep excavation.
			Operation & Maintenance series
20	1	Memo No. 723/BODHI/20/ R&C dt 29.3.86	Repair of concrete.
21	2	Memo No. 912/BODHI/20/ R&C/	Special care needed with regard to unobstructed outfall for C.D. works on canals.
			Testing & reaserch series
22.	1	Memo No. 718/BODHI/20/ R&C/dt 29.3.86	Guide lines for measurement , testing and analysis of seepage from masonry and concrete dams.

DRAFT CERCULARS PREPARED

1. Free board
2. Estimation of crop water requirement
3. Guide lines for design of measuring devices in canal
4. Type design of division box for micro net-work system
5. Type design of falls on micro net-work system
6. Guide lines for drainage behind lining in canal
7. Manual on canal outlets
8. Standard channel sections for minor ,water courses and field channels.

STATUS OF HYDRAULIC MODEL STUDIES AS ON JULY'88

S.No.	Name of projects for model studies	Present position of work in brief.	Type of model
1.	Indirasagar	2-D and 3-D models were constructed as per original designns and two specific reports were issued. Lowering of bucket invert and elimination of coffer dam for bulding up tail water were recommended by D.I.R. and accepted by DRP and CWC. The possibility of further raising the bucket invert of auxiliary spillway (from bay no. 13 to20 is under study) A 3-D model for stage construction study is also under construction,	2-D &3-D
2.	Maheshwar	2-D and 3-D models were construeted as per original design and specific report issued. Later on design discharge parameters were revised and model was again modified on the basis of new design. Studies will be conducted after verifcation of the model.	2-D & 3-D
3.	Hasdeo Bango	Studies were completed on 2-D model and report issued. Stage construction studies were completed for constructin period upto June 1988 and specific reports issued Additional study for sequencing of raising the block vis.a.vis. energy dissipation arrangement has also been taken up.	2-D & 3-D
4	Bansagar	Stage construction studies were completed for construction upto June 85 and observation reported. No further work is in progress as the project authorities have indicated that stage construction studies are not needed for the present	3-D
5.	Sondure	Energy dissipation studies were finalised on 2-D & 3-D models and three specific reports were issued. Later on the d/s configuration was modified as per letest survey report on recommendation by DRP and studies completed. Supplementry report is under issue.	2-D & 3-D
6.	Ruthai	Studies were completed on 2-D model and specific reports were issued. No comments received from field formation.	

7.	Sikassar	3-D model was constructed and observations were made for retrogation in downstream channel and total performance. Results were reported through specific report. On comments of DRP revised survey was done and part data has been received. However, as indicated by the C.E. M.G. basin further studies have been with held.	3-D
9.	Kolar	Studies completed and results reported. Comments not received.	2-D
9.	Bhadabhada Spillway.	Studies completed and report issued.	3-D
10.	Mahi Project	2-D model has been constructed.Observations kept abeyance for want of tail water rating curve from field authorities.	2-D
11.	Mahan project	Studies completed and specific report issued. No comments received.	2-D
12.	Gambhir	PHE Department has referred the problem for testing the effectiveness of E.D.A. provided in designs. Original designs of solid roller bucket was tried and report issued. Design was again modified and stilling basin was provided. This design was also tested and specific report issued. Further comments are awaited.	2-D

Note: - Two more studies for Barna and Dudhi have been received very recent Model studies will be taken up after complete details are provided by field formations.