

**REPORT
OF
THE COMMITTEE ON INSTRUMENTATION
FOR
DAMS & HYDRAULIC STRUCTURES**

PART I & II



**MINISTRY OF IRRIGATION AND POWER
GOVERNMENT OF INDIA
NEW DELHI**

December, 1965

सत्यमेव जयते

C.W. & P.C. No. 164

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(ii)

The Report is in two parts.

Part I is a general report dealing with the specific terms of reference embodied in the Government Resolution.

Part II (Separate Volume) is a detailed report describing necessity for instrumentation of important structures, the objectives to be sought, the nature of the measurements to be made and a description of the various instruments generally adopted for such measurements.

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BHAKRA & BEAS DESIGNS ORGANIZATION, KAKA NAGAR, NEW DELHI-11

No. 1044-47/CDE

December 28, 1965.

To

The Secretary to the Govt. of India,
Ministry of Irrigation & Power,
New Delhi-1.

SUBJECT :—*Final Report of the Committee on Instrumentation of Dams & Structures.*

Sir,

Pursuant to Resolution No. 20(31)/63-Policy, dated October 31, 1964, of the Government of India in the Ministry of Irrigation & Power, a Committee was constituted for the study of instrumentation of dams and structures in its various aspects. I have the pleasure to submit herewith the final report of this Committee.

The Report is in two parts. Part I is a general report dealing with the specific terms of reference embodied in the Government Resolution. Part II is a detailed statement of the necessity for instrumentation of important structures, the objectives to be sought, the nature of measurements to be made and a description of the various instruments generally adopted for such measurements. The Committee has felt it desirable to add Part II of the Report so as to provide the background in the context of which Part I of the Report has been written.

It is hoped that this Report will not only serve its direct purpose, *i.e.* to examine instrumentation in all its aspects including a review of the instrumentation already done in the country and to recommend the best ways and means for the effective implementation of measurement programmes in our hydraulic structures but will also be a useful technical reference for those who might plan similar programmes in the future.

Yours faithfully,

(P. S. BHATNAGAR)

Chairman,

Committee on Instrumentation of Dams & Structures.

Encl : Report in two parts.

Copy with enclosures to :

- (i) Chairman, Central Water & Power Commission, New Delhi.
- (ii) Member (Design & Research), Central Water & Power Commission.
- (iii) General Manager, Beas Project, Talwara.
- (iv) General Manager, Bhakra Dam, Nangal.
- (v) All Members of the Committee.

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INTRODUCTION

1. A Committee was constituted by the Government of India in the Ministry of Irrigation and Power by Resolution No. 20(31)/63-Policy, dated 31st October, 1964 (Appendix 0.01) for a study of instrumentation in various dams and hydraulic structures after visits to dams where necessary. The Resolution laid down the following terms of reference :—

- (i) To make a general review of the instrumentation done so far in various dams in the country including general examination of data and results obtained therefrom and their interpretation as indicative of structural action ;
- (ii) To assess future requirements of instruments upto the end of Fourth Plan, with particular reference to the requests of the projects now under construction ;
- (iii) To examine different types (such as Carlson elastic wire type, vibrating wire type etc.) of instruments and recommend the best suited for our projects ;
- (iv) To recommend the best arrangement for recording, storage, analysis and interpretation of field readings from instruments ;
- (v) To recommend the most suitable method of procurement of instruments for various State projects in the absence of indigenous products ;
- (vi) To examine the need for maintaining a stock of such instruments in the country, so that the requirements of projects can be properly met and instrumentation receives due implementation without any setback to the construction programme ; and
- (vii) To formulate a programme for the progressive manufacture of these instruments indigenously.

2. The Committee comprised the following members :—

- (i) Shri P. S. Bhatnagar,
Chief Design Engineer,
Bhakra & Beas Designs Organization,
Kaka Nagar, New Delhi. *Chairman.*
- (ii) Shri K. R. Datye,
Superintending Engineer,
Deccan Irrigation Circle III,
Nasik. *Member*
- (iii) Shri B. Pant,
Chief Research Officer,
Central Water & Power Research Station,
Poona. *Member*

- (iv) Shri I. P. Kapila,
Director Designs,
Bhakra & Beas Designs Organization,
Kaka Nagar, New Delhi. *Member*
- (v) Shri V. K. Sondhi,
Deputy Director,
Central Water & Power Commission.
Member-Secretary.

3. The Committee held the following meetings :—

Date of meeting	Place of meeting	Members attending
Dec. 15, 1964	Instrumentation Laboratory, C.W.&P.R.S., Poona.	Shri P. S. Bhatnagar Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
Jan. 28, 1965	Gandhi Sagar Dam, Circuit House.	Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
March 2, 1965	Koyna Dam, Rest House, Koyna.	Shri P. S. Bhatnagar Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
April 27, 1965	Bhakra & Beas Designs Organisation, N. Delhi.	Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
July 16 & 17, 1965	Instrumentation Lab. C.W. & P.R.S., Poona.	Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
August 6 & 7, 1965.	Bhakra & Beas Designs Organization, N. Delhi.	Shri P. S. Bhatnagar Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
August 24 & 25, 1965.	Office of S.E., Deccan, Irrigation Circle III, Nasik.	Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.
Oct. 20 & 21, 1965.	Bhakra & Beas Designs Organization, N. Delhi.	Shri P. S. Bhatnagar Shri I. P. Kapila Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi
Nov. 9 & 10, 1965.	Inspection House, Maharashtra Govt., Poona.	Shri P. S. Bhatnagar Shri K. R. Datye Shri B. Pant Shri V. K. Sondhi.

REPORT OF THE COMMITTEE ON INSTRUMENTATION FOR DAMS AND HYDRAULIC STRUCTURES

4. The Members of the Committee visited the following projects :—

- (a) Gandhi Sagar (visited by I. P. Kapila, K. R. Datye, B. Pant & V. K. Sondhi on 28th/29th Jan. 1965).
- (b) Ranapartap Sagar Dam under construction (visited by I. P. Kapila, K. R. Datye, B. Pant & V. K. Sondhi on 28th/29th Jan. 1965).
- (c) Kotah Barrage (visited by I. P. Kapila, K. R. Datye, B. Pant & V. K. Sondhi on 28th/29th Jan. 1965).
- (d) Kunnu Syphon Aqueduct (visited by K. R. Datye and B. Pant on 30th January, 1965).
- (e) Koyna Dam & Power Plant (visited by all members on March 2, 1965).
- (f) Sharavathy Project (visited by P. S. Bhatnagar, I. P. Kapila, and V. K. Sondhi on 5th March 1965, and K. R. Datye on 31-10-1965 to 2-11-1965).
- (g) Bhakra Dam (visited by K. R. Datye, B. Pant and V. K. Sondhi on 29th/30th April, 1965).
- (h) Hirakud Dam (visited by K. R. Datye on 24th/25th May, 1965).
- (i) Rihand Dam (visited by V. K. Sondhi on 29th to 31st July, 1965).
- (j) Tungabhadra Dam (visited by V. K. Sondhi on 10th/11th August, 1965).

In addition, the Committee had the advantage of first hand information with Shri K. R. Datye regarding Gangapur, Bor and Girna Dams in Maharashtra where instrumentation has been carried out.

5. Authorities concerned with the River Valley Projects in the Centre and various States were requested to supply particulars of instrumentation affected at projects under their control. This information was sought in two proforma statements (Appendix 0.02). Replies from 46 authorities were received, out of which 27 indicated that either no structure was under their charge or no instrumentation was provided, and 19 (covering 30 structures) supplied some information. The information as supplied or as collected is in respect of the following structures :—

- (a) *Concrete Dams*
Bhakra Dam
Koyna Dam
Rihand Dam
- (b) *Masonry Dams*
Gandhi Sagar Dam
Hirakud Dam
Linganamakki Dam

Malampuzha Dam
Mani Muthar Dam
Nagarjunasagar Dam
Parambikulam Aliyar Project
Tungabhadra Dam
Walayar Dam

(c) *Earth Dams*

Bor Dam
Buggavagu Dam
Dantiwada Dam
Datla Tank
Gangapur Dam
Ghod Dam
Girna Dam
Hathmati Dam
Hirakud Dam
Jirgo Dam
Kotah Barrage
Linganamakki Dam
Meshwa Dam
Nalganga Dam
Nanak Sagar Dam
Sampana Dam
Ukai Dam

(d) *Other Structures*

Bhira Tunnel
Koyna Head Race Tunnel
Koyna Power House Foundation
Koyna Pressure Shaft
Kunnu Syphon Aqueduct
Nagarjunasagar Right Canal Tunnel
Sharavathy Water Conductor System
Vir Dam.

The information is consolidated at Appendix 0.03.

6. As a result of detailed study of the information pertaining to instrumentation at various projects, discussions with project engineers, information obtained from persons outside India who are actively engaged in this work, discussion with representatives of manufacturers of instruments, and of the published literature on this subject, the Report of the Committee is submitted herewith. This report is in two parts. Part I is the general report dealing with the specific terms of reference embodied in the Resolution of the Government of India. Part II is the detailed report which deals with objectives of instrumentation, nature of measurements and their purpose and description of the various instruments generally adopted for such measurements. Detailed information pertaining to principles of working and construction, considerations governing location and layout, method of installation, observation and analysis of observed data has either

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been included or reference has been made to relevant technical publications. The Committee has felt it desirable to add Part II of the Report so as to provide the background in the context of which Part I of the Report has been written.

The Committee has not examined any measurements relating to stability of slopes within the reservoir area which affect the safety and utility of a structure, as this was outside the scope of the terms of reference. Measurements relating to meteorological data, and seismic characteristics of dams and structures have likewise not been examined as being outside the scope of the terms of reference of the Committee, except for the

brief mention wherever considered necessary in this report.

7. The work of the Committee was seriously handicapped by the fact that the Chairman was hospitalised for a period of four months from April to the end of July 1965. On this account the period for the submission of the Committee Report was first extended up to the end of September 1965 and subsequently up to the end of Dec. 1965 by Government of India, Ministry of Irrigation & Power Resolution No. 20(31)/63-Policy, dated 6th July, 1965 (Appendix 0.04) and Resolution No. 20(31), dated 29th September, 1965 (Appendix 0.05) respectively.

ACKNOWLEDGEMENTS

The Committee is specially indebted to Shri R. P. Sharma, Senior Design Engineer of Bhakra & Beas Designs Organization, New Delhi for his valuable contribution in the deliberations of the Committee and in compilation and editing the Committee Report.

The following officers also assisted in the work of the Committee:

Shri V. A. Parkash, Deputy Director and Shri N. C. Gupta, Asstt. Design Engineer, both of Bhakra & Beas Designs Organization, New Delhi; Shri Shiyekar, Asstt. Engineer of Deccan Irrigation Circle, Nasik; Shri A. S. Khot, Research Officer, Central Water & Power Research Station, Poona; Shri K. M. Nagbhushan, Asstt. Director and Shri R. N. Poddar, Asstt. Director, both of Central Water & Power Commission.

Typing of the final Report was done by Shri O. P. Gupta, Stenographer, Bhakra & Beas Designs Organization, New Delhi.