

GEOLOGICAL SURPRISES & MITIGATION MEASURES ADOPTED

CASE STUDIES RELATED TO SURFACE WORKS

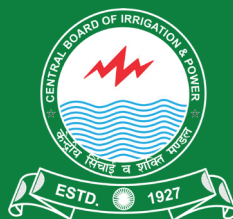


*WRD Series on
Hydroelectric & Pumped Storage Projects*

PART III / III

**GEOLOGICAL SURPRISES &
MITIGATION MEASURES ADOPTED**

Case Studies Related to Surface Works



Central Board of Irrigation and Power
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DISCLAIMER

This book titled “*Geological Surprises & Mitigation Measures Adopted*” is a compilation of information and data available in the various texts under ‘References’ as well as from websites on ‘Case Studies Related to Surface Works’ encompassing hydropower projects. The book is prepared for general information purpose. It is no way intended for any other purpose. Though all efforts have been made to present the data correctly, there may be errors. It does not constitute legal, engineering or technical advice.

Contribution made by all the Committee Members of Research Scheme on Power (RSoP) of Central Power Research Institute (CPRI), undertaken by CBIP previously in 2016, is duly acknowledged.

Front Cover :

Dam Under Construction - Subansiri Lower Hydroelectric Project Site.

Back Cover:

Foundation Excavation Activity in a Hydropower Project Site.

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FOREWORD

India is among the foremost countries in the world to utilise its water resources and is one of the world's leading hydropower producers, with a vast potential largely concentrated in the Himalayan region. In the present scenario, the nation's hydroelectric power sector is poised for growth with ongoing projects set to elevate the aggregate capacity to 67 GW by 2031-32, marking a substantial increase from the current 42 GW.

However, in this country, development of hydropower schemes involving dams and appurtenant structures in geologically complex regions often present significant engineering challenges, resulting in delays and consequent cost overruns. During project construction it becomes challenging, at times, for the project developers in effectively tackling adverse geological occurrences once faced, which demands a strategic approach and judicious implementation of apt tools and techniques.

This comprehensive book, titled, "Geological Surprises & Mitigation Measures Adopted", presents 'Case studies' that exemplify innovative measures and strategies adopted in effectively tackling major problems during execution of Surface Works in hydropower schemes, located in complex geological settings in the Himalayan and Peninsular regions in India, as well as in neighboring Bhutan Himalayas. Broadly, the detrimental geological problems encountered at the sites for dam and appurtenant surface structures include foundation issues, slope instability hazards in abutments/penstock area as well as power house back-slope instability, etc. The document provides the project developers with insights into the adverse geological issues and in strategically mitigating the consequential challenges.

This book forms the third part of the Water Resources Publication Series on: Hydroelectric Project & Pumped Storage Scheme Development. The Part-I book in this series presents the advance tools & techniques for efficient project development and the Part-II book embodies 'Case Studies' exemplifying measures adopted in tackling

the major geological problems in underground works. This Part-III book furnishes a compiled documentation of strategic comprehension & experiences in skillfully mitigating the geological problems encountered at different surface components, namely, dam, power house, penstock and other appurtenant hydropower project structures. It will be greatly useful for project developers in competently dealing with similar challenges when faced, and in establishing safe & sustainable projects in complex and varied geological settings, within the scheduled timeframe and finance.

I trust that this Part-III book brought out by CBIP, presenting a compendium of information and knowledge related to execution of surface works, will be of immense interest to all project developers and professionals presently involved in establishment of hydroelectric, pumped storage, and allied projects in this nation. I wish to compliment the members of the 'Publication Committee', for the dedicated efforts made by them in bringing out this valuable pragmatic document.



(Ghanshyam Prasad)



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PREFACE



It has been observed that, in India, while executing hydropower projects in complex geological environment, unforeseen geological conditions and associated geotechnical problems often pose major challenges, resulting in time and budgetary overruns. And there is a broad feeling, based on past experiences, that schemes involving superstructures like dam, power house and appurtenant components, take longer time than the schedule and delays are generally attributed to unforeseen “geological surprises”.

In fact, in execution of hydropower projects, the site geology and the corresponding construction methodology adopted are of overriding importance as they have significant bearing on the project schedule. In case of the surface components of hydropower schemes, the adverse geological problems broadly include existence of inhomogeneous, anisotropy, deep overburden in the river bed or buried channels, abrupt change in bed rock profile, occurrences of folds, fault zones/shear zones/fractured rock in foundation and slope instability hazards, etc. These detrimental issues present significant challenges while executing the diverse surface works of the project.

In this context, this book titled, *“Geological Surprises & Mitigation Measures Adopted”*, presents numerous ‘Case Studies’ of various geological problems that have been encountered during execution of the Surface Works in hydropower project sites, namely, dam and appurtenant surface structures located in complex geological set up and the corresponding measures undertaken in effectively mitigating the issues. The diverse issues encompass geological problems related to foundation, slope instabilities in abutments/penstock area as well as power house back-slope stability hazards, etc. Besides, the book also includes informative Chapters on: “Dam foundation & the significance of geological structure”, “Recent developments in cutoffs in dam foundation” and “Landslide mitigation & geosynthetics”. This book forms the Part-III of the Water Resources Publication Series on: Hydroelectric Project & Pumped Storage Scheme Development. The Part-I book released earlier is titled, “Advance Tools & Techniques for Efficient Project Development”. The Part-II book, in this series, embodies ‘Case Studies’ exemplifying measures adopted in tackling problems in underground works.

Earlier in 2016, CBIP had undertaken a research project under Research Scheme on Power (RSoP) program of Central Power Research Institute (CPRI), Bangalore, titled, “Compilation of Data on Latest Technologies in Geological & Geotechnical Investigations and Problems Faced & Mitigation Measures adopted during Execution”. However, since then, there has been further developments and accordingly, it was felt necessary to bring out this publication, presenting the updated information & documentation of various ‘Case Studies’. Moreover, the book also discusses about the challenges in hydropower project development in the Himalayan & Peninsular regions.

This valuable compendium encompasses “Case Studies” of hydropower schemes, located in the Himalayan and Peninsular regions in India, as well as in neighboring Bhutan Himalayas, sited in similar geological settings. The recorded documentation of knowledge and experiences brought out herein, in strategically mitigating the geological problems encountered at diverse surface components of hydropower schemes would be very useful guidance for hydroelectric and pumped storage project developers in competently dealing with similar detrimental challenges, by rationally deploying appropriate tools & techniques. And that would consequently result in efficiently establishing safe & sustainable projects in complex geological environment.

Aditya K. Dinkar
Secretary

Central Board of Irrigation and Power



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