World Bank funded hydropower projects

Sediment Management issues, challenges and lessons learnt

Workshop on Contracts Management
February 28-29, Vientiane, Laos

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The Bank has 102 projects supporting development or rehab of more than 473 dams.

Out of these 473 dams 32% are greenfield projects.
Today’s large hydropower projects are likely located in developing countries with limited capacity and remote locations.

Today we face greater concern for global issues than in the past:

- Climate change and other uncertainties
- Water scarcity and competing uses
- Greater environmental and social awareness
- Limited domestic consumption & often access to regional markets
- Global community and connectivity
• New directives for World Bank Group financing since 2013

• Screen all investments for short- and long-term climate change and disaster risks, and where risks exist, integrate appropriate resilience measures.

• COP21 in Paris paves the way for building resilience in the hydropower sector

• We need to look at all investments in the hydropower sector under the climate change lens and recommend appropriate resilience measures

• Resilience is the bridge between upstream work on climate change science and downstream work on real engineering works

• It is the Resilience angle that provides new opportunities in the hydropower sector for a revisit
Many investment decisions have long term consequences. Infrastructure in particular can shape development for decades or centuries, a duration that often extends beyond infrastructure’s lifetime because the economic system reorganizes itself around them.

“Prediction is very difficult, especially about the future”  (N. Bohr)

Year 2000, seen from 1900...  
(From Hildebrands)
In the early 1970s forecasters made projections of U.S. energy use based on a century of data...

...they were all wrong.
Mega-dams are a mega-waste of money and resources

BY ANDREW GELMAN  March 25 at 11:13 am

Fig. 4. Inaccuracy of cost estimates (local currencies, constant prices) for large dams over time (N=245), 1934–2007.

Fig. 5. Density trace of schedule slippage (N=239) with the median and mean.
Nine out of ten dams suffered cost overruns (Ansar et al. 2014).

When political interest is involved in project planning, project costs are strategically underestimated to attract financing and avoid public criticism of high-cost projects (Bacon et al. 1996).

Based on findings from previous studies on the cost planning of large construction projects, technical factors seem not to be the major cause of overruns; rather, experts’ optimistic perceptions about future events and political influence have been identified as the major reasons for overruns (Wachs, 1989; Pickrell, 1990; Flyvbjerg et al., 2005; Flyvbjerg, 2008).

The average real cost overruns for a portfolio of hydropower dams financed by the World Bank was found to be 27 percent, with a standard deviation of 38 percent. This shows that the uncertainties in hydropower investment estimates at appraisal stage are quite substantial (Awojobi and Jenkins 2015).

For the portfolio of 58 hydropower investments financed by the World Bank, the net benefits of dams are quite significant, with an EIRR in excess of 14 percent. The study concluded that hydropower dams are economically feasible, but that there is room for improvement in cost estimates.
WB funded projects uncertainties at appraisal stage are quite substantial.

range of accuracy of estimates, equal to estimated cost divided by final cost assuming constant currency value

pre-tender estimate, cost accuracy within ± 10 per cent

all tenders received, cost within ± 5 per cent

final cost

description of diagram

feasibility study, cost accuracy within ± 15 – 25 per cent

pre-feasibility study, cost accuracy within ± 40 – 50 per cent

time
EFFECTS OF INFLATION AND LOW ESTIMATES ON COST OVERRUNS

![Graph showing the effects of inflation and low estimates on cost overruns. The graph illustrates the cost overruns with different scenarios involving actual inflation rates of 12.6% and expected inflation of 4%, along with the pre-feasibility estimate being 40% too low. The initial cost estimate is shown at 16 x 10^6, the estimated final cost is at 25 x 10^6, and the actual final cost varies with time.](image-url)
RISK EXPOSURE IN HYDROPOWER PROJECTS

Who Should Cover Construction Risk?

- The State?
- The Private Investor?
- The Lenders?

Construction:
Project company draws down most of the loan to finance construction plus equipment purchase. Risk exposure grows. Grace period needed for hydro construction.

Start-Up:
Equipment tested, staffing completed, final payment to contractor, working capital needs, project gets exposed to commercial risk.

Operations:
Risk exposure declines as the loan is repaid. Length of this phase depends on repayment terms. Long tenor needed for hydros.

O&M spike

Hydros
- Capital Intensive
- Long Construction Phase

Loan Exposure ($)

Construction Phase
4 yrs

Start-Up Phase
1 yr

Operations Phase
15 yrs

Time →
1. Public Finance

Traditional (split/unit rate) → EPC → Modified EPC contracts

2. Project Finance
• First large hydropower projects implementation using EPC Contract started in the 90s.
• It was linked to the development of the Private Sector in hydropower generation.
• Today EPC contracts have gained popularity in both Public & Private Sectors.
CHAMERA HPP was one of the few projects in India built on time.
- good rock conditions
- initial bidding process failed because the bid prices were too high
- the project was rebid six years later
- contractors made their own evaluation of geological conditions to be comfortable.

URI HPP
- 9 months late
- utilized full 16% contingency.

DULHASTI HPP
- contractor abandoned the contract after 3 years claiming law and order issues (enabling him to claim insurance)
Advice from Ethiopian Engineers

FIDIC Silver Book:
“FIDIC EPC/Turnkey Conditions of Contract (Silver Book) are not suitable for use if construction will involve substantial work underground or work in other areas where tenderers cannot inspect”.

Standard conditions of contract for turnkey contracts:
NOT suitable where large proportion of civil works are involved

Hence documents would have to be “purpose designed”.
Building and engineering works
Designed by (or on behalf of) the Employer. The Contract is administered by the Engineer, appointed by the Employer. Disputes are referred to the Dispute Adjudication Board.

Electrical and/or mechanical plant and building and engineering works
Designed by (or on behalf of) the Contractor. The Contract is administered by the Engineer, appointed by the Employer. Disputes are referred to the Dispute Adjudication Board.

Process/power plant, a factory/similar facility, or an infrastructure project
Contractor takes total responsibility for the design and execution
The Contract is administered by the Employer. Disputes are referred to the Dispute Adjudication Board.
Changes from the 1999 Red Book

In terms of the presentation, the main difference between the 1999 Red Book and the Pink Book is the Particular Conditions, which have been divided in the Pink Book into Part A and Part B:

- Part A provides the information supplied by the Employer (the Contract Data), which is a renamed and partially re-structured "Appendix to Tender".

- Part B includes the Particular Conditions, which are a concise version of those contained in the 1999 Red Book.

World Bank tries to follow industry good practice
<table>
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<th>Sub clause</th>
<th>Amendment in the Pink Book</th>
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<td>2.4: Employer’s Financial Arrangements</td>
<td>Requires the Employer to submit the reasonable evidence “before the Commencement Date” as well as within 28 days of the Contractor’s request.</td>
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<td>2.5: Employer’s Claims</td>
<td>Requires the Employer to give notice within 28 days of the Employer becoming aware, or when it “should have become aware”, of the circumstances giving rise to the notice.</td>
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<td>3.1: The Engineer’s duties and authority</td>
<td>The Employer is allowed to change the authority of the Engineer without the agreement of the Contractor.</td>
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<td>3.5: Determinations</td>
<td>More onerous for the Engineer as it now fixes a time limit for the determination (28 days from receipt of the corresponding claim or request).</td>
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<td>15.6: Corrupt or Fraudulent Practices</td>
<td>A new clause dealing with corrupt or fraudulent practices has been inserted into the Pink Book.</td>
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<td>16.1: Contractor’s Entitlement to Suspend Work</td>
<td>If the Bank suspends payment of the funds from which the Contractor is paid, and no alternative funds are available, the Contractor can suspend or reduce the rate of work it performs at any time (having received a notice from the Bank).</td>
</tr>
<tr>
<td>16.2: Termination by Contractor</td>
<td>If the Bank suspends the loan or credit from which the Contractor is paid and 14 days after the Contractor has followed the payment mechanism under sub-clause 14.7 it has still has not received the sums due to it, the Contractor can suspend work, reduce its rate of work or terminate the Contract.</td>
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For the procurement of works through ICB in projects that are financed in whole or in part by the World Bank.

The General Conditions are the Bank Harmonized Edition of the Conditions of Contract for Construction prepared and copyrighted by FIDIC.

For use in contracts financed by the World Bank involving the design, supply, installation and commissioning of specially engineered plant and equipment, such as turbines & generators.
Considerable variations are found between predicted and actual conditions during execution, resulting in:

- significant cost and time overrun
- contractual complications
- uncertainties occur without warning

finding innovative solutions for quantifying uncertainties and assessing risks are therefore, key factors for successful operation of contract.
• Clearly defined responsibilities between parties.
• Uncertainty analysis.
• Risk management.
Tehri Hydro Development Corporation Limited is developing the 4X111 MW Vishnugad Pipalkoti Project. The World Bank project will consist of two components:

1. Construction of the 444 MW Vishnugad Pipalkoti Hydro Electric Project (US$ 656 million; Bank-funded portion); and

2. Technical assistance for capacity-building and institutional strengthening at THDC (US$ 10 million; Bank-funded portion).
Project implementation will be carried out mainly by four Contractors

1. Civil & Hydro-Mechanical Works,
2. Electromechanical Works,
3. Design Review Consultant (DRC) and
Civil & Hydro-Mechanical Works
EPC Contract for Civil Works and Hydro-Mechanical Equipment Works including Penstock Steel Liners, based on the World Bank’s Standard Bidding Documents for Procurement of Works (SBDW), prepared by the World Bank to be used for the procurement of unit price or rate type of works through ICB in projects that are financed by the World Bank.

Electromechanical Works
EPC contract for Electro-Mechanical Works, based on the World Bank’s SBD for “Procurement of Plant design, Supply and Installation”.

The interfaces are limited to: completion of powerhouse civil works to enable handover to M&E contractor; and completion of civil works and reservoir filling to enable commissioning of power plant.
Basic Design by the Employer

- Civil & Hydro Mechanical.
- Detailed hydraulic and geotechnical design.

Detailed design by the Contractor

- Contractor responsible for the detailed design & structural design subject to the approval of Engineer.

Design Review Consultant

- DRC responsible for review of the detailed design and drawings submitted by the Contractor.
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<td>Section VI F</td>
<td>Risk Assessment and Risk Register, Geological Baseline Report, Schedule</td>
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<td>Section IX</td>
<td>Annex. to the Particular Conditions – Contract Forms</td>
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Started with World Bank assistance, Upper Indravati Project is considered one of the largest multi-purpose projects in India.

Situated in drought prone districts (formerly HUNGER BASKET OF INDIA) of Kalahandi and Nawarangpur in Odisha, the project features transbasin diversion of water of river Indravati (Godavari basin) to river Hati (Mahanadi basin). The project provides irrigation to more than 100,000 hectares of land.
Thank you

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