Seminar on Hydro Power Projects
By
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Ideas for Faster Execution of Hydro Projects to Mitigate Time and Cost Overruns

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• Seemingly, the topic seems to be quite familiar and generic.

• Meaningful recommendations of several committees of experts, groups of stakeholders and conference organisers.

• But unfortunately, the delays are taken as obvious and also as normal.

• Still trying to complete at least one hydro project on time as per the timeline of approved feasibility report.

• So, - do we really have some sound ideas ?
Hydro projects are crucial in India’s sustainable development and energy security.

Hydropower plants have the ability to run at zero load - no outside source of power is needed to start.

Hydropower plants provide transient stability to the grid.

The quick start capability of hydropower plants helps quickly change the output to serve peak demand.

So - do we any doubt that the development of hydro power projects is inevitable?
So, the 1st idea
“Deal with the causes of delay in a comprehensive manner and concurrently. Certainly, not in isolated manner”.
A Study

- Nine out of ten hydro projects suffered time and cost overruns.

- Project costs are strategically underestimated to make the project attractive.

  - Technical factors not the major cause of overruns.

- Hydro projects are marred with several uncertainties in its life cycle.

  - Thus, uncertainties in hydropower at appraisal stage are quite substantial.

  - 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.
Varied responses to uncertainties of similar nature.

So, the 2nd idea

“Hand pick the people with real sound expertise and make them steer works at different levels. No experiments please.”
Picture of Koteshwar site as on 22.02.2007

22.02.2007
Picture of Koteshwar site as on 09.03.2011
PROJECT OWNER’s CONCERNS

• Completion within the stipulated time
• Minimum cost and no cost escalation
• Required quality as per specs
• Project’s expected performance during earning period
Possible Shortcomings Attributable to the Owner

• Absence of requisite approvals

• Insufficient site investigations

• Unrealistic cost estimates

• Imbalanced risk allocation

• Variations in design

• Delayed approvals for construction drawings
CONTRACTOR’s CONCERNS

• Maximize profits and avoid losses
• Most efficient use of resources
• Compress construction period to minimize fixed costs
• Implement strategy at completion from contractor’s perspective
Possible Shortcomings Attributable to Contractor

- Incompetence of management team
- Stressed cash liquidity
- Shortage of new and effective equipment
- Shortage of trained tradesmen and supervisors
- Failure to implement approved construction methodology
- Non-compliance with statutory requirements
FACTUAL POSITION

• Concerns are overlooked and shortcomings are not addressed adequately

So, the next idea

“Project Management has to assimilate the concerns on a consistent basis and place a sound plan on their dashboard to resolve shortcomings”
“Unexpected” – “Uncertainties” – “Unknowns”

In a hydro project, uncertainties such as
1. Changed hydrological and geological conditions.
2. Shortage of Material.
3. Sharp Increase in Material Price of Resources
4. Deterioration of Contractor’s financial strength.
5. Law and Order or Protests.
6. Court orders to modify project parameters of clearance stage
7. New Govt Regulations or Policies.

• These hinder, or even prevent accomplishment

• Innovative solutions for quantifying uncertainties and assessing risks - key factors for faster execution.
Tapovan Vishnugad (4x130 MW = 520MW)

- Executing Agency: NTPC
- Capacity : 4x130 MW = 520MW
- Original Commissioning schedule (4 units) - Mar’2013
- Anticipated Commissioning schedule (4 units) - Dec’2020
- Time overrun : 93 months
- Original Cost : Rs. 2978 crores (11/06 PL)
- Latest/anticipated cost : Rs. 3846 crores (01/14 PL)

- Reasons for time and cost overrun:
  - Heavy water ingress due to bad geology in HRT and rock fall on TBM. TBM stuck up thrice. (Risk Occurrence)
  - Flash flood in August 2012 and June 2013 damaging Coffer Dam. (Risk Occurrence)
  - Termination of Civil Contracts for Barrage and HRT. (Contractual Issues)
  - Cash Flow issues with Civil Contractors. (Contractual Issues)
Rammam-III (3x40 MW = 120 MW)

- Executing Agency: NTPC
- Capacity: 3x40 MW = 120 MW
- Original Commissioning schedule (all 3 units) - Sep’2019
- Anticipated Commissioning schedule (all 3 units) - Feb’2022
- Time overrun: 29 months
- Original Cost: Rs. 1381 crores (10/14 PL)
- Latest/anticipated cost: Approx Rs. 1800 crores (08/18 PL)
- **Reasons for time and cost overrun:**
  - Delay in getting permission from tree felling from Government of West Bengal for access road from Adit-1 to Adit-2. *(Delay in Govt Clearances)*
  - Cash Flow issues with Civil Contractors. *(Contractual Dispute)*
  - Strike/Bandh during Gorkhaland agitation. *(Law and Order)*
Kameng (4x150 MW = 600 MW)

- Executing Agency: NEEPCO
- Capacity: 4x150 MW = 600 MW
- Original Commissioning schedule all 4 units - Dec’ 2009
- Anticipated Commissioning schedule all 4 units - Oct’ 2018
- Time overrun: 106 months
- Original Cost: Rs. 2496 crores (03/04 PL)
- Latest/anticipated cost: Rs. 6179 crores (03/15 PL)

Reasons for time and cost overrun:
- Change in Dam parameters. (Design Change)
- Slow progress in Dam and HRT due to bad Geology, heavy seepage and inadequate deployment of machinery. (Risk Occurrence)
- Flash flood in October 2008 and September 2012. (Risk Occurrence)
- Ingress of water in HRT. (Risk Occurrence)
- Shortage of aggregates. (Risk Occurrence)
- Clearance of quarry from State Government. (Delay in Govt Clearances)
- Leakage from Penstocks and rectification of defects. (Quality Control)
- Cash flow issues with Civil Contractor. (Contractual Dispute)
Parbati II (4x200 MW = 800MW)

• Executing Agency: NHPC
• Capacity : 4x200 MW = 800MW
• Original Commissioning schedule all 4 units - Sep’2009
• Anticipated Commissioning schedule all 4 units - Dec’2020
• Time overrun: 135 months
• Original Cost: Rs. 3919 crores (12/01 PL)
• Latest/anticipated cost: Rs. 8398 crores (03/15 PL)
• **Reasons for time and cost overrun:**
  - Hon’ble High Court of Himachal Pradesh ban on stone crusher operation. *(Legal Court’s Ban)*
  - Delay in revised Forest clearance. *(Delay in Govt Clearances)*
  - TBM suffered extensive damage due to heavy ingress of water and slush in TBM face in Nov’ 2006. *(Risk Occurrence)*
  - Poor geology in HRT. *(Risk Occurrence)*
  - Cash Flow issues with Civil Contractor. *(Contractual Issues)*
Summing up the Uncertainties

- Technical
- Geological
- Social
- Contractual
- Managerial

Conventionally, uncertainties occurring at the project site were dealt with by making Engineering or contractual decisions.

Management of uncertainties performed in different ways at different projects.

A more systematic and rational approach is needed to resolve the problems.
Technical Problems
Technical Problems are Normally Manageable

• Judicious assessment of hydrological, geological and hydraulics parameters.
• Accurate and timely availability of design/drawings.
• Effective and modern construction methodology.
• Efficient equipment during construction.
• Appropriate and adequate resources on ground investigations at the pre-tender stage
**Infrastructure works at Pre-Construction Stage**

- Eats up a lot of construction time especially labour camps, roads and bridges.

- Pre-construction works
  - Arrangement for construction power
  - Construction of explosive magazine
  - Basic infrastructure such as approach roads, water and power (subject to availability of TEC of DPR from CEA & investment approval)
  - Simultaneous with EIA/EMP studies

- Planning and Procurement of Essential Equipment
Geological Problems
Geological Problems are Major and Quite Frequent Problems

- All hydro projects locations, rocks have undergone intense compression and thus are folded, faulted, foliated and jointed.
- Flowing ground conditions and high pressure seepage water.
- Supporting problems in shear zones, sometimes associated with intense water ingress.
- Possibility of encountering squeezing ground.
- Release of rock blocks due to Blocky and jointed strata.
- Rock bursts.
What is to be done?

• Only the Experts to handle the problems.
• Extensive geo investigations including surface mapping of rock exposures, aerial photo, satellite imageries, exploratory drift need to be carried out to ensure

1. Identification of the risks.
2. Evaluation of the risks.
3. Listing of the adequate geo-technical baseline conditions.
Further to Geo-Investigations and Identification of Risks

- Uncertainty analysis of all other conditions.
- Incorporation of responsibility matrix in contract.
- Elaboration of risk quantification mechanism.
- Risk management.
- Monitoring Plan.
- Acceptance of major risks.
Social Problems
Social Issues are very crucial and have large impact on time and cost.

- Local leaders crop up.
- Not allowing the contractors to work for their self interests.
- Employment demand of locals.
- Agitations and Dharnas by locals (Mostly at the quarry and disposal areas)
- Administration not extending adequate support.
- Land for ancillary works.
- Lack of accountability of State Authorities to maintain the law & order (Initiatives like ‘PRAGATI’ really helped).
Contractual Problems
Mostly the consequence of Geological, Financial and Technical problems.

- Contract Designs
  - EPC or Unit Rate
  - Responsibilities
- Aggressive Bidding.
- Interpretation of Contract Clauses (any lack of clarity should be decided quickly and positively).
- Disputes (Pragmatic mechanisms needed).
- Penalties (Don’t really help. Only complicate)
Selection of Bidder on Overall Objective Assessment of Competence

- Plant & Machinery,
- Executive Manpower,
- Ability to offer Performance Bank Guarantees,
- Amount of liquidity available
- Assign 70% credit score to the overall capabilities
- 30% financial credit score to the price competitiveness.

Modified Approach to Provision of Advances in Contract

- No provision of interest on mobilisation advance,
- Mobilisation advance to the tune of 1 or 2%
- Higher Equipment advance – 12 to 15%, interest free
- BoQ to have two portions. One - rates against BoQ and Other a %age lump sum amount based on monthly work done to setoff advances.

Escrow Account Provision
Enabling to use the project funds only on the project works.
Sharing Design Responsibilities

• The Owner shall be responsible for the basic design of the Civil and Hydro Mechanical Works including all major dimensions of the structures and instrumentation layout.

• Owner shall also be responsible for detailed hydraulic design and geo-technical design.

• Within the framework of the basic design, Contractor shall be responsible for carrying out the detailed design & structural design of all structures / works subject to the approval of Engineer.

• Payment terms will be based on the approved designs in accordance with the Bill of Quantities.
HANDLING CONTRACT INTERFACES

- **Tripartite Agreement** - Civil contractor to execute with the Owner and Electro-mechanical Contractor.

- Engineer-in-charge shall ensure
  - compliance of the responsibilities
  - a common schedule.

- DRC shall coordinate with Civil & HM, E&M contractors to ensure the adherence to the commissioning schedule.
RISK MANAGEMENT

• Includes
  - risk identification, risk assessment, risk analysis, risk allocation, risk mitigation and control.

• Comprehensive risk matrix in the Tender documents.

• Avoid, reduce, transfer and accept. But not to ignore.

• The risks may be allotted appropriately either to the Contractor or Employer.

• Work site belongs to Owner and Equipment/methodology related issues are Contractor’s responsibility
Owner’s Responsibility - Risk Management Process

Risk management strategy:
- Risk management responsibilities to be defined.
- Description of the activities to be carried out at different stages.
- Scheme to be used for follow-up on results obtained through the risk management activities.
- Comprehensive risk register.
- Follow-up on initial assumptions.
- Monitoring, audit and review procedures.
- Failure to define clearly the sharing of risks among the parties, is a major problem. The physical realities of the work do not have sound logic. These problems then result in difficulties during the project.
## SAMPLE RISK SHARING SHEET

<table>
<thead>
<tr>
<th>Risk / Hazard</th>
<th>Probability of Occurrence</th>
<th>Risk Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High water pressure</td>
<td>Medium</td>
<td>Employer</td>
</tr>
<tr>
<td>Swelling pressure</td>
<td>Medium</td>
<td>Employer</td>
</tr>
<tr>
<td>Stucking, Clamping of TBM</td>
<td>Medium</td>
<td>Contractor*</td>
</tr>
<tr>
<td>Face collapse by ground water flow</td>
<td>Medium</td>
<td>Contractor*</td>
</tr>
<tr>
<td>Gas detection</td>
<td>Medium</td>
<td>Contractor</td>
</tr>
</tbody>
</table>
MAJOR RISKS - CONTINGENCY PLAN

• Contract Document to speak out clearly on the Contingency Plan.

• Possibility of occurrence of major risks of low probability can’t be completely ruled out.

• Outcome of Major risks to be accepted and to be addressed at the start.

• Contingency plan at his cost to be elaborated by the Owner and made a part of tender document.
Managerial or Supervisional Problems
Managerial or Supervisional problems are certainly avoidable

- Consistent construction monitoring
  - avoidance of trouble,
  - assurance of quality and
  - delivery on the ground.
- Consistent construction monitoring involves
  - setting up of objectives,
  - assessment of critical items,
  - planning & organising,
  - personnel management,
  - trouble free contract management.
- Adoption of an appropriate mechanism for reducing time and cost over-runs.
Managerial Issues – Ideas

(1) Use of technology
(2) Attention to smaller milestones and critical items
(3) IT enabled network planning
(4) Need based planning
   i) Equipment planning
   ii) Material planning
   iii) Evaluation of working cycle.
(5) Job and Management Factors
(6) PRMs to avoid processing delays and render opportunity to understand the bigger picture
(7) Consistent Innovations in construction methodology
FINAL IDEA TO LOOK ELSEWHERE (For inspiration)

Project Delivery *Models*

- Traditional
- Standard
- Modern
- Emerging based on country’s needs
Conclusions

• Deal with the causes comprehensively.

• Domain expertise to be roped in and cannot be ignored.

• Project Management to assimilate concerns and resolve shortcomings.

• Manage “Unexpected”, “Uncertainties” and “Unknowns”.

• Risk management requires much experience, practical and theoretical knowledge.

• Broad Criteria of Managing risks - avoid, reduce, transfer and accept. But not to ignore.

• Systematic risk management techniques – potential problems identified - risk mitigation measures implemented in a timely manner.

• Provisions in Contract should allow quick response to uncertainties.

• Risk Matrix to be defined with equitable responsibility.
Summing-up
Faster Execution of Hydro Projects  (Part-1):

3) Speedy clearances from Govts including Forest and Environment.
4) Accountability of States in Land Acquisition and R&R issues.
1) Arranging/Raising finance to meet the capital cost of the projects.
2) Adequate Survey and Investigation including Geological Exploration to minimize surprises during execution.
5) Parallel award of contracts for Civil, Electro-Mechanical & Hydro-Mechanical Works.
6) Need to locate/develop adequate number of Erection and Construction Agencies.
7) Need to induct adequate number of state-of-the-art construction equipment at project site.
8) Development of proper infrastructure facilities like roads, construction power and reliable telecommunication system.
Summing-up

Faster Execution of Hydro Projects  (Part-2):

9) Arranging/training enough skilled manpower.
10) Need to introduce IT based project management and monitoring with online connectivity with Suppliers, Project Authorities, Consultants and Contractors.
11) Contractual issues.
14) Identify and address shortcomings related to valuation of changed conditions.
15) Identify and address shortcomings related to Time Extensions.
16) Provide proper mechanism for fixation of rates for extra items.
17) Identify and address shortcomings related to Dispute Resolution.
THANKS